PHILOSOPHICAL

AND

MISCELLANEOUS PAPERS.

Lately written by

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ADVERTISEMENT.

SOME years ago a volume in quarto, intituled, "Experiments and Obſervations on "Electricity," *&c. together with* "Letters and "Papers on Philoſophical Subjects," *by Dr. Franklin, was publiſhed; and afterwards another volume in octavo, intituled,* "Political, Miſcel- "laneous, and Philoſophical Pieces."

The Papers now offered to the public were written ſince the former publications; and the Editor expects ſhortly to be able to ſubjoin a Second, to this Firſt Part, and thereby to complete the volume.

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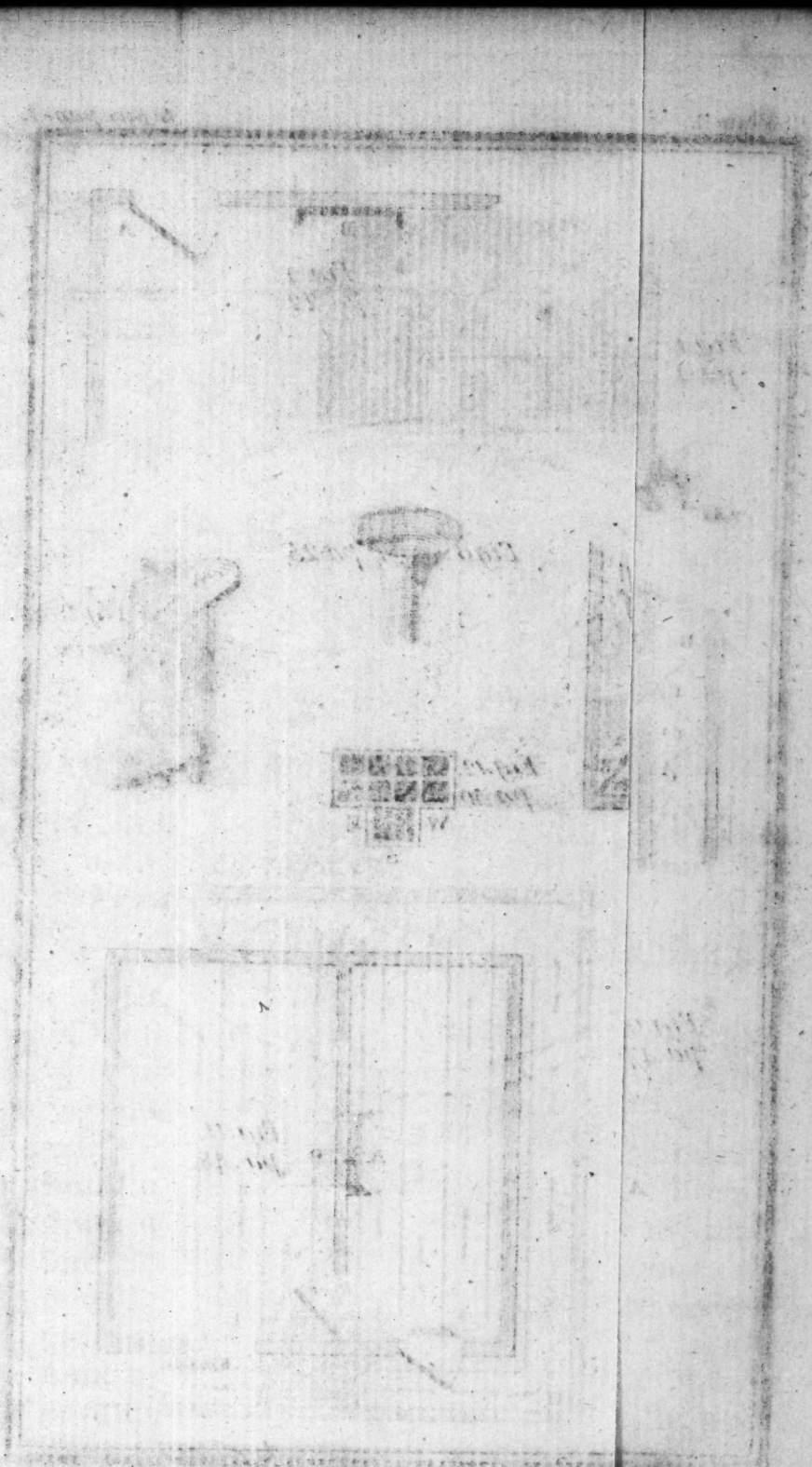

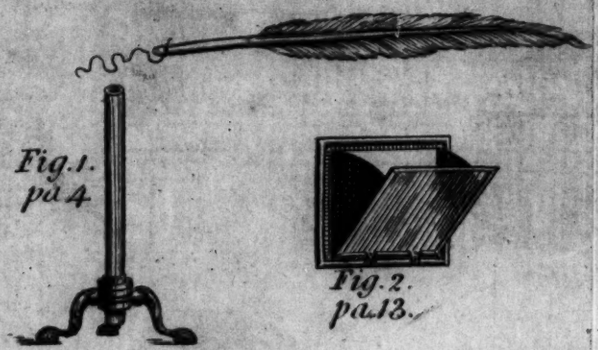

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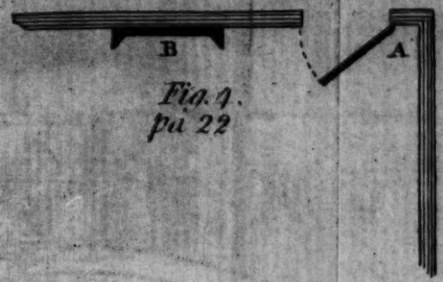

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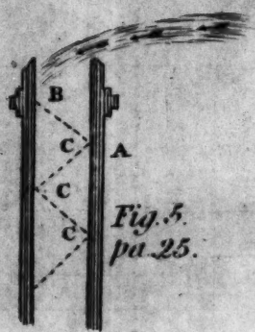

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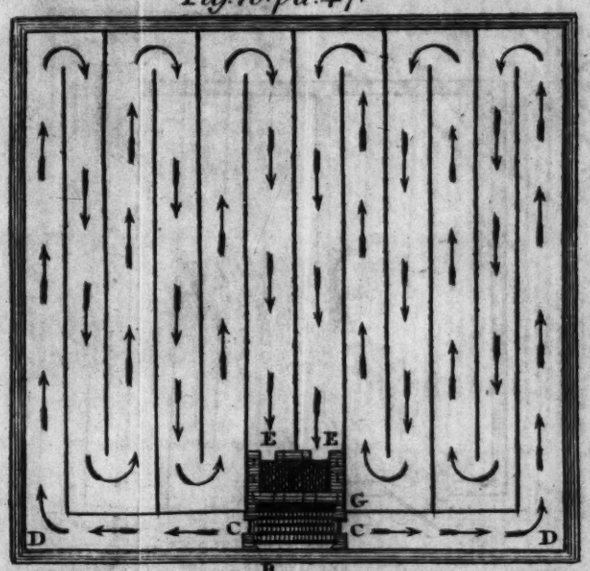

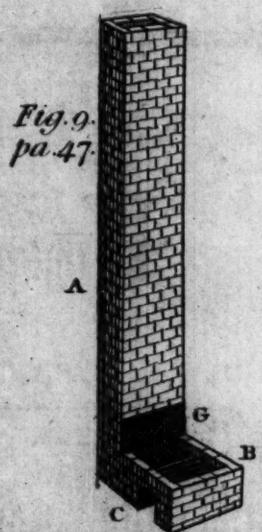

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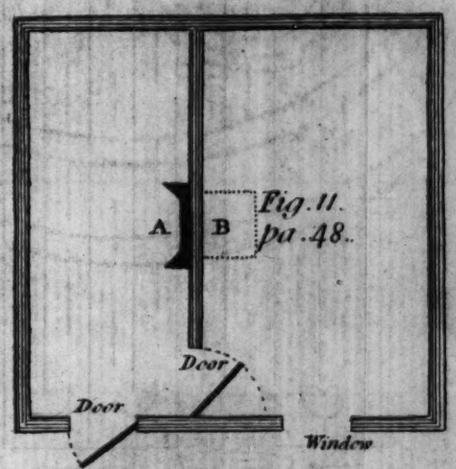

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PHILOSOPHICAL AND MISCELLANEOUS PAPERS.

A Letter from Dr. B. FRANKLIN *to Dr.* INGENHAUSZ, *Phyſician to the Emperor, at Vienna.*

At ſea, Auguſt 28th, 1785.

Dear Friend,

IN one of your letters, a little before I left France, you deſire me to give you in writing my thoughts upon the conſtruction and uſe of chimneys, a ſubject you had ſometimes heard me touch upon in converſation. I embrace willingly this leiſure afforded by my preſent ſituation to comply with your requeſt, as it will not only ſhow my regard to the deſires of a friend, but may at the ſame time be of ſome utility to others; the doctrine of chimneys appearing not to be as yet generally well

underſtood, and miſtakes reſpecting them being attended with conſtant inconvenience, if not remedied; and with fruitleſs expence, if the true remedies are miſtaken.

Thoſe who would be acquainted with this ſubject ſhould begin by conſidering on what principle ſmoke aſcends in any chimney. At firſt many are apt to think that ſmoke is in its nature and of itſelf ſpecifically lighter than air, and riſes in it for the ſame reaſon that cork riſes in water. Theſe ſee no cauſe why ſmoke ſhould not riſe in the chimney, though the room be ever ſo cloſe. Others think there is a power in chimneys to *draw* up the ſmoke, and that there are different forms of chimneys which afford more or leſs of this power. Theſe amuſe themſelves with ſearching for the beſt form. The equal dimenſions of a funnel in its whole length is not thought artificial enough, and it is made, for fancied reaſons, ſometimes tapering and narrowing from below upwards, and ſometimes the contrary, &c. &c. A ſimple experiment or two may ſerve to give more correct ideas. Having lit a pipe of tobacco, plunge the ſtem to the bottom of a decanter half filled with cold water; then putting a rag over the bowl, blow through it and make the ſmoke deſcend in the ſtem of the pipe, from the end of which it will riſe in bubbles through the water; and being thus cooled, will not afterwards riſe to go out through the neck of the decanter, but remain ſpreading itſelf and reſting

ing on the ſurface of the water. This ſhows that ſmoke is really heavier than air, and that it is carried upwards only when attached to, or acted upon, by air that is heated, and thereby rarefied and rendered ſpecifically lighter than the air in its neighbourhood.

Smoke being rarely ſeen but in company with heated air, and its upward motion being viſible, though that of the rarefied air that drives it is not ſo, has naturally given riſe to the error.

I need not explain to you, my learned friend, what is meant by rarefied air; but if you make the public uſe you propoſe of this letter, it may fall into the hands of ſome who are unacquainted with the term and with the thing. Theſe then may be told, that air is a fluid which has weight as well as others, though about eight hundred times lighter than water. That heat makes the particles of air recede from each other and take up more ſpace, ſo that the ſame weight of air heated will have more bulk, than equal weights of cold air which may ſurround it, and in that caſe muſt riſe, being forced upwards by ſuch colder and heavier air, which preſſes to get under it and take its place. That air is ſo rarefied or expanded by heat, may be proved to their comprehenſion by a lank-blown bladder, which laid before a fire will ſoon ſwell, grow tight, and burſt.

Another experiment may be to take a glaſs tube about an inch in diameter, and twelve inches long, open at both ends, and fixed upright on legs ſo that it need not be handled, for the hands might warm it. At the end of a quill faſten five or ſix inches of the fineſt light filament of ſilk, ſo that it may be held either above the upper end of the tube or under the lower end, your warm hand being at a diſtance by the length of the quill. If there were any motion of air through the tube, it would manifeſt itſelf by its effect on the ſilk; but if the tube and the air in it are of the ſame temperature with the ſurrounding air, there will be no ſuch motion, whatever may be the form of the tube, whether crooked or ſtrait, narrow below and widening upwards, or the contrary; the air in it will be quieſcent. Warm the tube, and you will find, as long as it continues warm, a conſtant current of air entering below and paſſing up through it, till diſcharged at the top; becauſe the warmth of the tube being communicated to the air it contains, rarefies that air, and makes it lighter than the air without, which therefore preſſes in below, forces it upwards, follows and takes its place, and is rarefied in its turn. And, without warming the tube, if you hold under it a knob of hot iron, the air thereby heated will riſe and fill the tube, going out at its top, and this motion in the tube will continue as long

Plate I. Figure 1.

as

as the knob remains hot, becauſe the air entering the tube below is heated and rarefied by paſſing near and over that knob.

That this motion is produced merely by the difference of ſpecific gravity between the fluid within and that without the tube, and not by any fancied form of the tube itſelf, may appear by plunging it into water contained in a glaſs jar a foot deep, through which ſuch motion might be ſeen. The water within and without the tube being of the ſame ſpecific gravity, balance each other, and both remain at reſt. But take out the tube, ſtop its bottom with a finger, and fill it with olive oil, which is lighter than water, then ſtopping the top, place it as before, its lower end under water, its top a very little above. As long as you keep the bottom ſtopt, the fluids remain at reſt, but the moment it is unſtopt, the heavier enters below, forces up the lighter, and takes its place. And the motion then ceaſes, merely becauſe the new fluid cannot be ſucceſſively made lighter, as air may be by a warm tube.

In fact, no form of the funnel of a chimney has any ſhare in its operation or effect reſpecting ſmoke, except its height. The longer the funnel, if erect, the greater its force when filled with heated and rarefied air, to *draw* in below and drive up the ſmoke, if one may, in compliance with cuſtom, uſe the expreſſion *draw*, when in fact it is the ſuperior weight of

the ſurrounding atmoſphere that *preſſes* to enter the funnel below, and ſo *drives up* before it the ſmoke and warm air it meets with in its paſſage.

I have been the more particular in explaining theſe firſt principles, becauſe, for want of clear ideas reſpecting them, much fruitleſs expence has been occaſioned; not only ſingle chimneys, but in ſome inſtances, within my knowledge, whole ſtacks having been pulled down and rebuilt with funnels of different forms, imagined more powerful in *drawing* ſmoke; but having ſtill the ſame height and the ſame opening below, have performed no better than their predeceſſors.

What is it then which makes a *ſmoky chimney*, that is, a chimney which inſtead of conveying up all the ſmoke, diſcharges a part of it into the room, offending the eyes, and damaging the furniture?

The cauſes of this effect, which have fallen under my obſervation, amount to *nine*, differing from each other, and therefore requiring different remedies.

1. *Smoky chimneys, in a new houſe, are ſuch frequently from mere want of air.* The workmanſhip of the rooms being all good, and juſt out of the workman's hand, the joints of the boards of the flooring, and of the pannels of wainſcotting, are all true and tight, the more ſo as the walls, perhaps not yet thoroughly dry, preſerve a dampneſs in the air of the room which

which keeps the wood-work ſwelled and cloſe. The doors and the ſaſhes too, being worked with truth, ſhut with exactneſs, ſo that the room is as tight as a ſnuff-box, no paſſage being left open for air to enter, except the key-hole, and even that is ſometimes covered by a little dropping ſhutter. Now if ſmoke cannot riſe but as connected with rarefied air, and a column of ſuch air, ſuppoſe it filling the funnel, cannot riſe, unleſs other air be admitted to ſupply its place; and if, therefore, no current of air enter the opening of the chimney, there is nothing to prevent the ſmoke coming out into the room. If the motion upwards of the air in a chimney that is freely ſupplied, be obſerved by the riſing of the ſmoke or a feather in it, and it be conſidered that in the time ſuch feather takes in riſing from the fire to the top of a chimney, a column of air equal to the content of the funnel muſt be diſcharged, and an equal quantity ſupplied from the room below, it will appear abſolutely impoſſible that this operation ſhould go on if the tight room is kept ſhut; for were there any force capable of drawing conſtantly ſo much air out of it, it muſt ſoon be exhauſted like the receiver of an air-pump, and no animal could live in it. Thoſe therefore who ſtop every crevice in a room to prevent the admiſſion of freſh air, and yet would have their chimney carry up the ſmoke, require inconſiſtencies, and expect impoſſibilities. Yet, under this ſituation, I have

ſeen the owner of a new houſe, in deſpair, and ready to ſell it for much leſs than it coſt, conceiving it uninhabitable, becauſe not a chimney in any one of its rooms would carry off the ſmoke, unleſs a door or window were left open. Much expence has alſo been made, to alter and amend new chimneys which had really no fault; in one houſe particularly that I knew, of a nobleman in Weſtminſter, that expence amounted to no leſs than three hundred pounds, *after* his houſe had been, as he thought, finiſhed, and all charges paid. And after all, ſeveral of the alterations were ineffectual, for want of underſtanding the true principles.

Remedies. When you find, on trial, that opening the door or a window enables the chimney to carry up all the ſmoke, you may be ſure that want of air *from without* was the cauſe of its ſmoking. I ſay *from without*, to guard you againſt a common miſtake of thoſe who may tell you, the room is large, contains abundance of air, ſufficient to ſupply any chimney, and therefore it cannot be that the chimney wants air. Theſe reaſoners are ignorant, that the largeneſs of a room, if tight, is in this caſe of ſmall importance, ſince it cannot part with a chimney full of its air without occaſioning ſo much vacuum; which it requires a great force to effect, and could not be borne if effected.

It appearing plainly, then, that ſome of the outward air muſt be admitted, the queſtion will

will be, how much is *abſolutely neceſſary*; for you would avoid admitting more, as being contrary to one of your intentions in having a fire viz. that of warming your room. To diſcover this quantity, ſhut the door gradually while a middling fire is burning, till you find that, before it is quite ſhut, the ſmoke begins to come out into the room, then open it a little till you perceive the ſmoke comes out no longer. There hold the door, and obſerve the width of the open crevice between the edge of the door and the rabbit it ſhould ſhut into. Suppoſe the diſtance to be half an inch, and the door eight feet high, you find thence that your room requires an entrance for air equal in area to ninety-ſix half inches, or forty-eight ſquare inches, or a paſſage of ſix inches by eight. This however is a large ſuppoſition, there being few chimneys that, having a moderate opening and a tolerable height of funnel, will not be ſatisfied with ſuch a crevice of a quarter of an inch; and I have found a ſquare of ſix by ſix, or thirty-ſix ſquare inches, to be a pretty good medium, that will ſerve for moſt chimneys. High funnels with ſmall and low openings, may indeed be ſupplied through a leſs ſpace, becauſe, for reaſons that will appear hereafter, the *force of levity*, if one may ſo ſpeak, being greater in ſuch funnels, the cool air enters the room with greater velocity, and conſequently more enters in the ſame time. This however has its limits, for

experience

experience ſhows that no increaſed velocity ſo occaſioned, has made the admiſſion of air through the key-hole equal in quantity to that through an open door; though through the door the current moves ſlowly, and through the key-hole with great rapidity.

It remains then to be conſidered how and where this neceſſary quantity of air from without is to be admitted ſo as to be leaſt inconvenient. For, if at the door, left ſo much open, the air thence proceeds directly to the chimney, and in its way comes cold to your back and heels as you ſit before your fire. If you keep the door ſhut, and raiſe a little the ſaſh of your window, you feel the ſame inconvenience. Various have been the contrivances to avoid this, ſuch as bringing in freſh air through pipes in the jams of the chimney, which pointing upwards ſhould blow the ſmoke up the funnel; opening paſſages into the funnel above, to let in air for the ſame purpoſe. But theſe produce an effect contrary to that intended: For as it is the conſtant current of air paſſing from the room *through the opening of the chimney* into the funnel, which prevents the ſmoke coming out into the room, if you ſupply the funnel by other means or in other ways with the air it wants, and eſpecially if that air be cold, you diminiſh the force of that current, and the ſmoke, in its efforts to enter the room, finds leſs reſiſtance.

The

The wanted air muſt then *indiſpenſably* be admitted into the room, to ſupply what goes off through the opening of the chimney. M. Gauger, a very ingenious and intelligent French writer on the ſubject, propoſes with judgment to admit it *above* the opening of the chimney; and to prevent inconvenience from its coldneſs, he directs its being made to paſs in its entrance through winding cavities made behind the iron back and ſides of the fire-place, and under the iron hearth-plate; in which cavities it will be warmed, and even heated, ſo as to contribute much, inſtead of cooling, to the warming of the room. This invention is excellent in itſelf, and may be uſed with advantage in building new houſes; becauſe the chimneys may then be ſo diſpoſed, as to admit conveniently the cold air to enter ſuch paſſages: but in houſes built without ſuch views, the chimneys are often ſo ſituated, as not to afford that convenience without great and expenſive alterations. Eaſy and cheap methods, though not quite ſo perfect in themſelves, are of more general utility; and ſuch are the following.

In all rooms where there is a fire, the body of air warmed and rarefied before the chimney is continually changing place, and making room for other air that is to be warmed in its turn. Part of it enters and goes up the chimney, and the reſt riſes and takes place near the ceiling.

ceiling. If the room be lofty, that warm air remains above our heads as long as it continues warm, and we are little benefited by it, becauſe it does not deſcend till it is cooler. Few can imagine the difference of climate between the upper and lower parts of ſuch a room, who have not tried it by the thermometer, or by going up a ladder till their heads are near the ceiling. It is then among this warm air that the wanted quantity of outward air is beſt admitted, with which being mixed, its coldneſs is abated, and its inconvenience diminiſhed ſo as to become ſcarce obſervable. This may be eaſily done, by drawing down about an inch the upper ſaſh of a window; or, if not moveable, by cutting ſuch a crevice through its frame; in both which caſes, it will be well to place a thin ſhelf of the length, to conceal the opening, and ſloping upwards to direct the entering air horizontally along and under the ceiling. In ſome houſes the air may be admitted by ſuch a crevice made in the wainſcot, cornice, or plaiſtering, near the ceiling and over the opening of the chimney. This, if practicable, is to be choſen, becauſe the entering cold air will there meet with the warmeſt riſing air from before the fire, and be ſooneſt tempered by the mixture: the ſame kind of ſhelf ſhould alſo be placed here. Another way, and not a very difficult one, is to take out an upper pane of glaſs in one of your

ſaſhes,

ſaſhes, ſet it in a tin frame, giving it two ſpringing angular ſides, and then replacing it, with hinges below on which it may be turned to open more or leſs above. It will then have the appearance of an internal ſky-light. By drawing this pane in, more or leſs, you may admit what air you find neceſſary. Its poſition will naturally throw that air up and along the ceiling. This is what is called in France a *Was iſt das?* As this is a German queſtion, the invention is probably of that nation, and takes its name from the frequent aſking of that queſtion when it firſt appeared. In England, ſome have of late years cut a round hole about five inches diameter in a pane of the ſaſh, and placed againſt it a circular plate of tin hung on an axis, and cut into vanes, which being ſeparately bent a little obliquely, are acted upon by the entering air, ſo as to force the plate continually round like the vanes of a windmill. This admits the outward air, and by the continual whirling of the vanes, does in ſome degree diſperſe it. The noiſe only is a little inconvenient. Plate I. Figure 2.

2. A ſecond cauſe of the ſmoking of chimneys is, *their openings in the room being too large*; that is, too wide, too high, or both. Architects in general have no other ideas of proportion in the opening of a chimney, than what relate to ſymmetry and beauty, reſpecting the dimenſions of the room*; while its

* See Appendix, N° I.

true

true proportion, reſpecting its function and utility, depends on quite other principles; and they might as properly proportion the ſtep in a ſtaircaſe to the height of the ſtory, inſtead of the natural elevation of men's legs in mounting. The proportion then to be regarded, is what relates to the height of the funnel. For as the funnels in the different ſtories of a houſe are neceſſarily of different heights or lengths, that from the loweſt floor being the higheſt or longeſt, and thoſe of the other floors ſhorter and ſhorter, till we come to thoſe in the garrets, which are of courſe the ſhorteſt; and the force of draught being, as already ſaid, in proportion to the height of funnel filled with rarefied air; and a current of air from the room into the chimney, ſufficient to fill the opening, being neceſſary to oppoſe and prevent the ſmoke coming out into the room; it follows that the openings of the longeſt funnels may be larger, and that thoſe of the ſhorter funnels ſhould be ſmaller. For if there be a large opening to a chimney that does not draw ſtrongly, the funnel may happen to be furniſhed with the air it demands by a partial current entering on one ſide of the opening, and leaving the other ſide free of any oppoſing current, may permit the ſmoke to iſſue there into the room. Much too of the force of draught in a funnel depends on the degree of rarefaction in the air it contains, and that depends on the nearneſs to the fire of its paſſage in entering the funnel. If

it

it can enter far from the fire on each ſide, or far above the fire, in a wide or high opening, it receives little heat in paſſing by the fire, and the contents of the funnel is by that means leſs different in levity from the ſurrounding atmoſphere, and its force in drawing conſequently weaker. Hence if too large an opening be given to chimneys in upper rooms, thoſe rooms will be ſmoky: on the other hand, if too ſmall openings be given to chimneys in the lower rooms, the entering air operating too directly and violently on the fire, and afterwards ſtrengthening the draught as it aſcends the funnel, will conſume the fuel too rapidly.

Remedy. As different circumſtances frequently mix themſelves in theſe matters, it is difficult to give preciſe dimenſions for the openings of all chimneys. Our fathers made them generally much too large; we have leſſened them; but they are often ſtill of greater dimenſion than they ſhould be, the human eye not being eaſily reconciled to ſudden and great changes. If you ſuſpect that your chimney ſmokes from the too great dimenſion of its opening, contract it by placing moveable boards ſo as to lower and narrow it gradually, till you find the ſmoke no longer iſſues into the room. The proportion ſo found will be that which is proper for that chimney, and you may employ the bricklayer or maſon to reduce it accordingly. However, as, in building new houſes, ſomething muſt be ſometimes hazarded,

I would make the openings in my lower rooms about thirty inches ſquare and eighteen deep, and thoſe in the upper only eighteen inches ſquare, and not quite ſo deep; the intermediate ones diminiſhing in proportion as the height of funnel diminiſhed. In the larger openings, billets of two feet long, or half the common length of cord-wood, may be burnt conveniently; and for the ſmaller, ſuch wood may be ſawed into thirds. Where coals are the fuel, the grates will be proportioned to the openings. The ſame depth is nearly neceſſary to all, the funnels being all made of a ſize proper to admit a chimney-ſweeper. If in large and elegant rooms, cuſtom or fancy ſhould require the appearance of a larger chimney, it may be formed of expenſive marginal decorations, in marble, &c. In time perhaps that which is fitteſt in the nature of things, may come to be thought handſomeſt. But at preſent, when men and women in different countries ſhow themſelves diſſatisfied with the forms God has given to their heads, waiſts, and feet, and pretend to ſhape them more perfectly, it is hardly to be expected that they will be content always with the beſt form of a chimney. And there are ſome, I know, ſo bigotted to the fancy of a large noble opening, that, rather than change it, they would ſubmit to have damaged furniture, ſore eyes, and ſkins almoſt ſmoked to bacon.

3. Another

3. Another cauſe of ſmoky chimneys is, *too ſhort a funnel.* This happens neceſſarily in ſome caſes, as where a chimney is required in a low building; for, if the funnel be raiſed high above the roof, in order to ſtrengthen its draught, it is then in danger of being blown down, and cruſhing the roof in its fall.

Remedies. Contract the opening of the chimney, ſo as to oblige all the entering air to paſs through or very near the fire; whereby it will be more heated and rarefied, the funnel itſelf be more warmed, and its contents have more of what may be called the force of levity, ſo as to riſe ſtrongly and maintain a good draught at the opening.

Or you may in ſome caſes, to advantage, build additional ſtories over the low building, which will ſupport a high funnel.

If the low building be uſed as a kitchen, and a contraction of the opening therefore inconvenient, a large one being neceſſary, at leaſt when there are great dinners, for the free management of ſo many cooking utenſils; in ſuch caſe I would adviſe the building of two more funnels joining to the firſt, and having three moderate openings, one to each funnel, inſtead of one large one. When there is occaſion to uſe but one, the other two may be kept ſhut by ſliding plates, hereafter to be deſcribed *; and two or all of them may be

* See Appendix, N° II.

uſed together when wanted. This will indeed be an expence, but not an uſeleſs one, ſince your cooks will work with more comfort, ſee better than in a ſmoky kitchen what they are about, your victuals will be cleaner dreſſed, and not taſte of ſmoke, as is often the caſe; and to render the effect more certain, a ſtack of three funnels may be ſafely built higher above the roof than a ſingle funnel.

The caſe of too ſhort a funnel is more general than would be imagined, and often found where one would not expect it. For it is not uncommon, in ill-contrived buildings, inſtead of having a funnel for each room or fire-place, to bend and turn the funnel of an upper room ſo as to make it enter the ſide of another funnel that comes from below. By this means the upper room funnel is made ſhort of courſe, ſince its length can only be reckoned from the place where it enters the lower room funnel; and that funnel is alſo ſhortened by all the diſtance between the entrance of the ſecond funnel and the top of the ſtack: for all that part being readily ſupplied with air through the ſecond funnel, adds no ſtrength to the draught, eſpecially as that air is cold when there is no fire in the ſecond chimney. The only eaſy remedy here is, to keep the opening ſhut of that funnel in which there is no fire.

4. Another very common cauſe of the ſmoking of chimneys is, *their overpowering one another*. For inſtance, if there be two chimneys in

in one large room, and you make fires in both of them, the doors and windows cloſe ſhut, you will find that the greater and ſtronger fire ſhall overpower the weaker, and draw air down its funnel to ſupply its own demand; which air deſcending in the weaker funnel will drive down its ſmoke, and force it into the room. If, inſtead of being in one room, the two chimneys are in two different rooms, communicating by a door, the caſe is the ſame whenever that door is open. In a very tight houſe, I have known a kitchen chimney on the loweſt floor, when it had a great fire in it, overpower any other chimney in the houſe, and draw air and ſmoke into its room, as often as the door was opened communicating with the ſtaircaſe.

Remedy. Take care that every room have the means of ſupplying itſelf from without with the air its chimney may require, ſo that no one of them may be obliged to borrow from another, nor under the neceſſity of lending. A variety of theſe means have been already deſcribed.

5. Another cauſe of ſmoking is, *when the tops of chimneys are commanded by higher buildings, or by a hill,* ſo that the wind, blowing over ſuch eminences, falls like water over a dam, ſometimes almoſt perpendicularly on the tops of the chimneys that lie in its way, and beats down the ſmoke contained in them.

Remedy. That commonly applied to this caſe, is a turncap made of tin or plate iron, covering the chimney above and on three ſides, open on one ſide, turning on a ſpindle, and which, being guided or governed by a vane, always preſents its back to the current. This, I believe, may be generally effectual, though not certain, as there may be caſes in which it will not ſucceed. Raiſing your funnels, if practicable, ſo as their tops may be higher, or at leaſt equal with the commanding eminence, is more to be depended on. But the turning cap, being eaſier and cheaper, ſhould firſt be tried. If obliged to build in ſuch a ſituation, I would chuſe to place my doors on the ſide next the hill, and the backs of my chimneys on the furtheſt ſide; for then the column of air falling over the eminence, and of courſe preſſing on that below, and forcing it to enter the doors or *was-iſt-das*es on that ſide, would tend to balance the preſſure down the chimneys, and leave the funnels more free in the exerciſe of their functions.

6. There is another caſe of command, the reverſe of that laſt-mentioned. It is where the commanding eminence is farther from the wind than the chimney commanded. To explain this a figure may be neceſſary. Suppoſe then a building whoſe ſide A, happens to be expoſed to the wind, and forms a kind of dam againſt its progreſs. The air obſtructed by this dam will, like water, preſs

Plate I. Figure 3.

preſs and ſearch for paſſages through it; and finding the top of the chimney B, below the top of the dam, it will force itſelf down that funnel, in order to get through by ſome door or window open on the other ſide of the building. And if there be a fire in ſuch chimney, its ſmoke is of courſe beat down, and fills the room.

Remedy. I know of but one, which is to raiſe ſuch funnel higher than the roof, ſupporting it, if neceſſary, by iron bars. For a turncap in this caſe has no effect, the dammed up air preſſing down through it in whatever poſition the wind may have placed its opening.

I know a city in which many houſes are rendered ſmoky by this operation; for their kitchens being built behind, and connected by a paſſage with the houſes, and the tops of the kitchen chimneys lower than the tops of the houſes, the whole ſide of a ſtreet, when the wind blows againſt its back, forms ſuch a dam as above deſcribed; and the wind ſo obſtructed forces down thoſe kitchen chimneys (eſpecially when they have but weak fires in them) to paſs through the paſſage and houſe into the ſtreet. Kitchen chimneys ſo formed and ſituated have another inconvenience: in ſummer, if you open your upper room windows for air, a light breeze blowing over your kitchen chimney towards the houſe, though not ſtrong enough to force down its ſmoke as aforeſaid,

is ſufficient to waft it into your windows, and fill the rooms with it; which, beſides the diſagreeableneſs, damages your furniture.

7. Chimneys, otherwiſe drawing well, are ſometimes made to ſmoke by *the improper and inconvenient ſituation of a door*. When the door and chimney are on the ſame ſide of the room as in the figure, if the door A, being in the corner is made to open againſt the wall, which is common, as being there, when open, more out of the way, it follows, that when the door is only opened in part, a current of air ruſhing in, paſſes along the wall into and acroſs the opening of the chimney B, and flirts ſome of the ſmoke out into the room. This happens more certainly when the door is ſhutting, for then the force of the current is augmented, and becomes very inconvenient to thoſe who, warming themſelves by the fire, happen to ſit in its way.

Plate I. Figure 4.

The *Remedies* are obvious and eaſy. Either put an intervening ſcreen from the wall round great part of the fire-place; or, which is perhaps preferable, ſhift the hinges of your door, ſo as it may open the other way, and when open, throw the air along the other wall.

8. A room that has no fire in its chimney is ſometimes filled with *ſmoke, which is received at the top of its funnel, and deſcends into the room*. In a former paper * I have already ex-

* See Appendix, N° II.

plained

plained the deſcending currents of air in cold funnels; it may not be amiſs however to repeat here, that funnels without fires have an effect, according to their degree of coldneſs or warmth, on the air that happens to be contained in them. The ſurrounding atmoſphere is frequently changing its temperature; but ſtacks of funnels, covered from winds and ſun by the houſe that contains them, retain a more equal temperature. If, after a warm ſeaſon, the outward air ſuddenly grows cold, the empty warm funnels begin to draw ſtrongly upward; that is, they rarefy the air contained in them, which of courſe riſes, cooler air enters below to ſupply its place, is rarefied in its turn, and riſes; and this operation continues, till the funnel grows cooler, or the outward air warmer, or both, when the motion ceaſes. On the other hand, if, after a cold ſeaſon, the outward air ſuddenly grows warm, and of courſe lighter, the air contained in the cool funnels, being heavier, deſcends into the room; and the warmer air which enters their tops, being cooled in its turn, and made heavier, continues to deſcend; and this operation goes on, till the funnels are warmed by the paſſing of warm air through them, or the air itſelf grows cooler. When the temperature of the air and of the funnels is nearly equal, the difference of warmth in the air between day and night is ſufficient to produce theſe currents, the air will begin to aſcend the funnels as the cool of the evening

comes on, and this current will continue till perhaps nine or ten o'clock the next morning, when it begins to heſitate; and as the heat of the day approaches, it ſets downwards, and continues ſo till towards evening, when it again heſitates for ſome time, and then goes upwards conſtantly during the night, as before mentioned. Now when ſmoke iſſuing from the tops of neighbouring funnels paſſes over the tops of funnels which are at the time drawing downwards, as they often are in the middle part of the day, ſuch ſmoke is of neceſſity drawn into theſe funnels, and deſcends with the air into the chamber.

The *Remedy* is, to have a ſliding plate, hereafter deſcribed *, that will ſhut perfectly the offending funnel.

9. Chimneys which generally draw well, do nevertheleſs ſometimes give ſmoke into the rooms, *it being driven down by ſtrong winds paſſing over the tops of their funnels*, though not deſcending from any commanding eminence. This caſe is moſt frequent where the funnel is ſhort, and the opening turned from the wind. It is the more grievous, when it happens to be a cold wind that produces the effect, becauſe when you moſt want your fire you are ſometimes obliged to extinguiſh it. To underſtand this, it may be conſidered that the riſing light air, to obtain a free iſſue from

* See Appendix, N° II.

the

the funnel, muſt puſh out of its way, or oblige the air that is over it to riſe. In a time of calm, or of little wind, this is done viſibly, for we ſee the ſmoke that is brought up by that air riſe in a column above the chimney. But when a violent current of air, that is, a ſtrong wind, paſſes over the top of a chimney, its particles have received ſo much force, which keeps them in a horizontal direction, and follow each other ſo rapidly, that the riſing light air has not ſtrength ſufficient to oblige them to quit that direction and move upwards to permit its iſſue. Add to this, that ſome of the current paſſing over that ſide of the funnel which it firſt meets with, viz. at A, having been compreſſed by the reſiſtance of the funnel, may expand itſelf over the flue, and ſtrike the interior oppoſite ſide at B, from whence it may be reflected downwards, and from ſide to ſide, in the direction of the pricked lines c c c. Plate I. Figure 5.

Remedies. In ſome places, particularly in Venice, where they have not ſtacks of chimneys but ſingle flues, the cuſtom is, to open or widen the top of the flue rounding in the true form of a funnel; which ſome think may prevent the effect juſt mentioned, for that the wind blowing over one of the edges into the funnel may be ſlanted out again on the other ſide by its form. I have had no experience of this; but I have Plate I. Figure 6.

lived

lived in a windy country, where the contrary is practiſed, the tops of the flues being *narrowed* inwards, ſo as to form a ſlit for the iſſue of the ſmoke, long as the breadth of the funnel, and only four inches wide. This ſeems to have been contrived on a ſuppoſition that the entry of the wind would thereby be obſtructed; and perhaps it might have been imagined, that the whole force of the riſing warm air being condenſed, as it were, in the narrow opening, would thereby be ſtrengthened, ſo as to overcome the reſiſtance of the wind. This however did not always ſucceed; for when the wind was at north-eaſt, and blew freſh, the ſmoke was forced down by fits into the room I commonly ſat in, ſo as to oblige me to ſhift the fire into another. The poſition of the ſlit of this funnel was indeed north-eaſt and ſouth-weſt. Perhaps if it had lain acroſs the wind, the effect might have been different. But on this I can give no certainty. It ſeems a matter proper to be referred to experiment. Poſſibly a turncap might have been ſerviceable, but it was not tried.

Chimneys have not been long in uſe in England. I formerly ſaw a book, printed in the time of queen Elizabeth, which remarked the then modern improvements of living, and mentioned among others the convenience of chimneys. "Our forefathers," ſaid the author, "had no chimneys. There was in each dwell-"ing-houſe only a place for a fire, and the "ſmoke

" ſmoke went out through a hole in the roof;
" but now there is ſcarce a gentleman's houſe
" in England that has not at leaſt one chim-
" ney in it."—When there was but one chim-
ney, its top might then be opened as a funnel, and perhaps, borrowing the form from the Venetians, it was then the flue of a chimney got that name. Such is now the growth of luxury, that in both England and France we muſt have a chimney for every room, and in ſome houſes every poſſeſſor of a chamber, and almoſt every ſervant, will have a fire; ſo that the flues being neceſſarily built in ſtacks, the opening of each as a funnel is impracticable. This change of manners ſoon conſumed the firewood of England, and will ſoon render fuel extremely ſcarce and dear in France, if the uſe of coals be not introduced in the latter kingdom, as it has been in the former, where it at firſt met with oppoſition; for there is extant in the records of one of queen Elizabeth's parliaments, a motion made by a member, reciting, " that many dyers, brewers, ſmiths,
" and other artificers of London, had of late
" taken to the uſe of pitcoal for their fires,
" inſtead of wood, which filled the air with
" noxious vapours and ſmoke, very prejudicial
" to the health, particularly of perſons com-
" ing out of the country; and therefore mov-
" ing that a law might paſs to prohibit the
" uſe of ſuch fuel (at leaſt during the ſeſſion
" of parliament) by thoſe artificers."—It ſeems

it

it was not then commonly uſed in private houſes. Its ſuppoſed unwholeſomeneſs was an objection. Luckily the inhabitants of London have got over that objection, and now think it rather contributes to render their air ſalubrious, as they have had no general peſtilential diſorder ſince the general uſe of coals, when, before it, ſuch were frequent. Paris ſtill burns wood at an enormous expence continually augmenting, the inhabitants having ſtill that prejudice to overcome. In Germany you are happy in the uſe of ſtoves, which ſave fuel wonderfully: your people are very ingenious in the management of fire; but they may ſtill learn ſomething in that art from the Chineſe *, whoſe country being greatly populous and fully cultivated, has little room left for the growth of wood, and having not much other fuel that is good, have been forced upon many inventions, during a courſe of ages, for making a little fire go as far as poſſible.

I have thus gone through all the common cauſes of the ſmoking of chimneys that I can at preſent recollect as having fallen under my obſervation; communicating the remedies that I have known ſucceſsfully uſed for the different caſes, together with the principles on which both the diſeaſe and the remedy depend, and confeſſing my ignorance wherever I have been ſenſible of it. You will do well, if you pub-

* See Appendix, N° III.

liſh,

liſh, as you propoſe, this letter, to add in notes, or as you pleaſe, ſuch obſervations as may have occured to your attentive mind; and if other philoſophers will do the ſame, this part of ſcience, though humble, yet of great utility, may in time be perfected. For many years paſt, I have rarely met with a caſe of a ſmoky chimney, which has not been ſolvable on theſe principles, and cured by theſe remedies, where people have been willing to apply them; which is indeed not always the caſe; for many have prejudices in favour of the noſtrums of pretending chimney-doctors and fumiſts, and ſome have conceits and fancies of their own, which they rather chuſe to try, than to lengthen a funnel, alter the ſize of an opening, or admit air into a room, however neceſſary; for ſome are as much afraid of freſh air as perſons in the hydrophobia are of freſh water. I myſelf had formerly this prejudice, this *aerophobia*, as I now account it, and dreading the ſuppoſed dangerous effects of cool air, I conſidered it as an enemy, and cloſed with extreme care every crevice in the rooms I inhabited. Experience has convinced me of my error. I now look upon freſh air as a friend; I even ſleep with an open window. I am perſuaded that no common air from without, is ſo unwholeſome as the air within a cloſe room that has been often breathed and not changed. Moiſt air too, which formerly I thought pernicious, gives me now no apprehenſions: for conſidering that no dampneſs

dampneſs of air applied to the outſide of my ſkin, can be equal to what is applied to and touches it within, my whole body being full of moiſture, and finding that I can lie two hours in a bath twice a week, covered with water, which certainly is much damper than any air can be, and this for years together, without catching cold, or being in any other manner diſordered by it, I no longer dread mere moiſture, either in air or in ſheets or ſhirts: and I find it of importance to the happineſs of life, the being freed from vain terrors, eſpecially of objects that we are every day expoſed inevitably to meet with. You phyſicians have of late happily diſcovered, after a contrary opinion had prevailed ſome ages, that freſh and cool air does good to perſons in the ſmall-pox and other fevers. It is to be hoped that in another century or two we may all find out, that it is not bad even for people in health. And as to moiſt air, here I am at this preſent writing in a ſhip with above forty perſons, who have had no other but moiſt air to breathe for ſix weeks paſt; every thing we touch is damp, and nothing dries, yet we are all as healthy as we ſhould be on the mountains of Switzerland, whoſe inhabitants are not more ſo than thoſe of Bermuda or St. Helena, iſlands on whoſe rocks the waves are daſhed into millions of particles, which fill the air with damp, but produce no diſeaſes, the moiſture being pure, unmixed with the poiſonous vapours

vapours ariſing from putrid marſhes and ſtagnant pools, in which many inſects die and corrupt the water. Theſe places only, in my opinion, (which however I ſubmit to yours) afford unwholeſome air; and that it is not the mere water contained in damp air, but the volatile particles of corrupted animal matter mixed with that water, which renders ſuch air pernicious to thoſe who breathe it. And I imagine it a cauſe of the ſame kind that renders the air in cloſe rooms, where the perſpirable matter is breathed over and over again by a number of aſſembled people, ſo hurtful to health. After being in ſuch a ſituation, many find themſelves affected by that *febricula*, which the Engliſh alone call *a cold*, and, perhaps from the name, imagine that they caught the malady by *going out* of the room, when it was in fact by being in it.

You begin to think that I wander from my ſubject, and go out of my depth. So I return again to my chimneys.

We have of late many lecturers in experimental philoſophy. I have wiſhed that ſome of them would ſtudy this branch of that ſcience, and give experiments in it as a part of their lectures. The addition to their preſent apparatus need not be very expenſive. A number of little repreſentations of rooms, compoſed each of five panes of ſaſh glaſs, framed in wood at the corners, with proportionable doors, and moveable glaſs chimneys, with openings of different

ferent ſizes, and different lengths of funnel, and ſome of the rooms ſo contrived as to communicate on occaſion with others, ſo as to form different combinations, and exemplify different caſes; with quantities of green wax taper cut into pieces of an inch and half, ſixteen of which ſtuck together in a ſquare, and lit, would make a ſtrong fire for a little glaſs chimney, and blown out would continue to burn and give ſmoke as long as deſired. With ſuch an apparatus all the operations of ſmoke and rarefied air in rooms and chimneys might be ſeen through their tranſparent ſides; and the effect of winds on chimneys, commanded or otherwiſe, might be ſhown by letting the entering air blow upon them through an opened window of the lecturer's chamber, where it would be conſtant while he kept a good fire in his chimney. By the help of ſuch lectures our fumiſts would become better inſtructed. At preſent they have generally but one remedy, which perhaps they have known effectual in ſome one caſe of ſmoky chimneys, and they apply that indiſcriminately to all the other caſes, without ſucceſs,—but not without expence to their employers.

With all the ſcience, however, that a man ſhall ſuppoſe himſelf poſſeſſed of in this article, he may ſometimes meet with caſes that ſhall puzzle him. I once lodged in a houſe at London, which, in a little room, had a ſingle chimney and funnel. The opening was very

ſmall, yet it did not keep in the ſmoke, and all attempt to have a fire in this room were fruitleſs. I could not imagine the reaſon, till at length obſerving that the chamber over it, which had no fire-place in it, was always filled with ſmoke when a fire was kindled below, and that the ſmoke came through the cracks and crevices of the wainſcot; I had the wainſcot taken down, and diſcovered that the funnel which went up behind it, had a crack many feet in length, and wide enough to admit my arm, a breach very dangerous with regard to fire, and occaſioned probably by an apparent irregular ſettling of one ſide of the houſe. The air entering this breach freely, deſtroyed the drawing force of the funnel. The remedy would have been, filling up the breach, or rather rebuilding the funnel: but the landlord rather choſe to ſtop up the chimney.

Another puzzling caſe I met with at a friend's country-houſe near London. His beſt room had a chimney in which, he told me, he never could have a fire, for all the ſmoke came out into the room. I flattered myſelf I could eaſily find the cauſe, and preſcribe the cure. I had a fire made there, and found it as he ſaid. I opened the door, and perceived it was not want of air. I made a temporary contraction of the opening of the chimney, and found that it was not its being too large that cauſed the ſmoke to iſſue. I went out and looked up at the top of the

chimney: its funnel was joined in the ſame ſtack with others, ſome of them ſhorter, that drew very well, and I ſaw nothing to prevent its doing the ſame. In fine, after every other examination I could think of, I was obliged to own the inſufficiency of my ſkill. But my friend, who made no pretenſion to ſuch kind of knowledge, afterwards diſcovered the cauſe himſelf. He got to the top of the funnel by a ladder, and looking down, found it filled with twigs and ſtraw cemented by earth, and lined with feathers. It ſeems the houſe, after being built, had ſtood empty ſome years before he occupied it; and he concluded that ſome large birds had taken the advantage of its retired ſituation to make their neſt there. The rubbiſh, conſiderable in quantity, being removed, and the funnel cleared, the chimney drew well, and gave ſatisfaction.

In general, ſmoke is a very tractable thing, eaſily governed and directed when one knows the principles, and is well informed of the circumſtances. You know I made it *deſcend* in my Pennſylvania ſtove. I formerly had a more ſimple conſtruction, in which the ſame effect was produced, but viſible to the eye. It was compoſed of two plates A B and C D, placed as in the figure. The lower plate A B reſted with its edge in the angle made by the hearth with the back of the chimney. The upper plate was fixed to the breaſt, and lapt over the lower about ſix inches, leaving

Plate I. Figure 7.

leaving a ſpace of four inches wide and the length of the plates (near two feet) between them. Every other paſſage of air into the funnel was well ſtopped. When therefore a fire was made at E, for the firſt time with charcoal, till the air in the funnel was a little heated through the plates, and then wood laid on, the ſmoke would riſe to A, turn over the edge of that plate, deſcend to D, then turn under the edge of the upper plate, and go up the chimney. It was pretty to ſee, but of no great uſe. Placing therefore the under plate in a higher ſituation, I removed the upper plate C D, and placed it perpendicularly, ſo that the upper edge of the lower plate A B came within about three inches of it, and might be puſhed farther from it, or ſuffered to come nearer to it, by a moveable wedge between them. The flame then aſcending from the fire at E, was carried to ſtrike the upper plate, made it very hot, and its heat roſe and ſpread with the rarefied air into the room. Plate I. Figure 8.

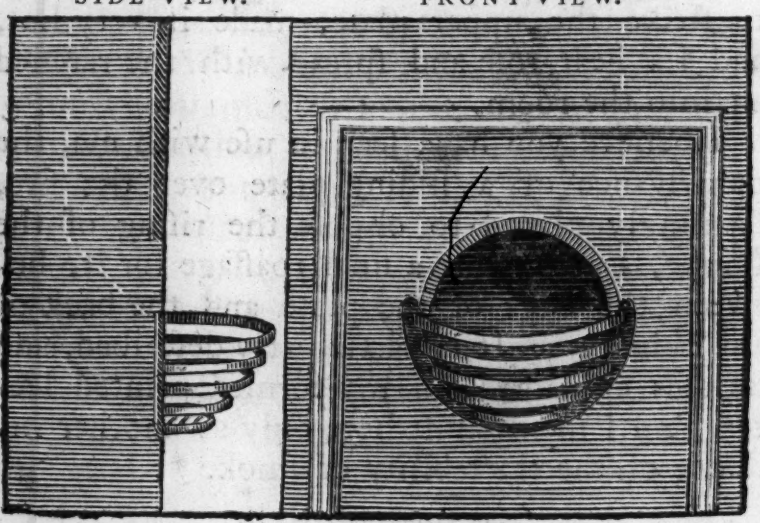
I believe you have ſeen in uſe with me, the contrivance of a ſliding-plate over the fire, ſeemingly placed to oppoſe the riſing of the ſmoke, leaving but a ſmall paſſage for it, between the edge of the plate and the back of the chimney. It is particularly deſcribed, and its uſes explained, in my former printed letter, and I mention it here only as another inſtance of the tractability of ſmoke *.

* See Appendix, N° II.

What is called the Staffordſhire chimney, affords an example of the ſame kind. The opening of the chimney is bricked up, even with the fore-edge of its jams, leaving open only a paſſage over the grate of the ſame width, and perhaps eight inches high. The grate conſiſts of ſemicircular bars, their upper bar of the greateſt diameter, the others under it ſmaller and ſmaller, ſo that it has the appearance of half a round baſket. It is, with the coals it contains, wholly without the wall that ſhuts up the chimney, yet the ſmoke bends and enters the paſſage above it, the draught being ſtrong, becauſe no air can enter that is not obliged to paſs near or through the fire, ſo that all that the funnel is filled with is much heated, and of courſe much rarefied.

STAFFORDSHIRE FIRE-PLACE.

SIDE VIEW. FRONT VIEW.



Much

Much more of the proſperity of a winter country depends on the plenty and cheapneſs of fuel, than is generally imagined. In travelling I have obſerved, that in thoſe parts where the inhabitants can have neither wood, nor coal, nor turf, but at exceſſive prices, the working people live in miſerable hovels, are ragged, and have nothing comfortable about them. But where fuel is cheap (or where they have the art of managing it to advantage) they are well furniſhed with neceſſaries, and have decent habitations. The obvious reaſon is, that the working hours of ſuch people are the profitable hours, and they who cannot afford ſufficient fuel, have fewer ſuch hours in the twenty-four than thoſe who have it cheap and plenty: for much of the domeſtic work of poor women, ſuch as ſpinning, ſewing, knitting; and of the men, in thoſe manufactures that require little bodily exerciſe, cannot well be performed where the fingers are numbed with cold: thoſe people, therefore, in cold weather, are induced to go to bed ſooner, and lie longer in a morning, than they would do if they could have good fires or warm ſtoves to ſit by; and their hours of work are not ſufficient to produce the means of comfortable ſubſiſtence. Thoſe public works, therefore, ſuch as roads, canals, &c. by which fuel may be brought cheap into ſuch countries from diſtant places, are of great utility; and thoſe

who promote them may be reckoned among the benefactors of mankind.

I have great pleaſure in having thus complied with your requeſt, and in the reflection that the friendſhip you honour me with, and in which I have ever been ſo happy, has continued ſo many years without the ſmalleſt interruption. Our diſtance from each other is now augmented, and nature muſt ſoon put an end to the poſſibility of my continuing our correſpondence: but if conſciouſneſs and memory remain in a future ſtate, my eſteem and reſpect for you, my dear friend, will be everlaſting.

B. F.

APPEN.

APPENDIX.

NOTES FOR THE LETTER UPON CHIMNEYS.

N° I.

THE lateſt work on architecture that I have ſeen, is that entitled NUTSHELLS, which appears to be written by a very ingenious man, and contains a table of the proportions of the openings of chimneys; but they relate ſolely to the proportions he giveshis rooms, without the ſmalleſt regard to the funnels. And he remarks, reſpecting thoſe proportions, that they are ſimilar to the harmonic diviſions of a monochord *. He does not indeed lay much ſtreſs on this; but it ſhows that we like the appearance of principles; and where we have not true ones, we have ſome ſatisfaction in producing ſuch as are imaginary.

N° II.

THE deſcription of the ſliding plates here promiſed, and which hath been ſince brought into uſe under various names, with

* "It may be juſt remarked here, that upon comparing theſe "proportions with thoſe ariſing from the common diviſions of "the monochord, it happens that the firſt anſwers to uniſon, "and although the ſecond is a diſcord, the third anſwers to the "third minor, the fourth to the third major, the fifth to the "fourth, the ſixth to the fifth, and the ſeventh to the octave." NUTSHELLS, page 85.

ſome immaterial changes, is contained in a former letter to J. B. Eſq. as follows:

To J. B. *Eſq. at Boſton, in New-England.*

Dear Sir, London, Dec. 2, 1758.

I HAVE executed here an eaſy ſimple contrivance, that I have long ſince had in ſpeculation, for keeping rooms warmer in cold weather than they generally are, and with leſs fire. It is this. The opening of the chimney is contracted, by brick-work faced with marble ſlabs, to about two feet between the jams, and the breaſt brought down to within about three feet of the hearth.—An iron frame is placed juſt under the breaſt, and extending quite to the back of the chimney, ſo that a plate of the ſame metal may ſlide horizontally backwards and forwards in the grooves on each ſide of the frame. This plate is juſt ſo large as to fill the whole ſpace, and ſhut the chimney entirely when thruſt quite in, which is convenient when there is no fire. Drawing it out, ſo as to leave a ſpace between its further edge and the back, of about two inches; this ſpace is ſufficient for the ſmoke to paſs; and ſo large a part of the funnel being ſtopt by the reſt of the plate, the paſſage of warm air out of the room, up the chimney, is obſtructed and retarded, and by that means much cold air is prevented from coming in through crevices, to ſupply its place. This effect is made manifeſt three ways,

ways. Firſt, when the fire burns briſkly in cold weather, the howling or whiſtling noiſe made by the wind, as it enters the room through the crevices, when the chimney is open as uſual, ceaſes as ſoon as the plate is ſlid in to its proper diſtance. Secondly, opening the door of the room about half an inch, and holding your hand againſt the opening, near the top of the door, you feel the cold air coming in againſt your hand, but weakly, if the plate be in. Let another perſon ſuddenly draw it out, ſo as to let the air of the room go up the chimney, with its uſual freedom where chimneys are open, and you immediately feel the cold air ruſhing in ſtrongly. Thirdly, if ſomething be ſet againſt the door, juſt ſufficient, when the plate is in, to keep the door nearly ſhut, by reſiſting the preſſure of the air that would force it open: then, when the plate is drawn out, the door will be forced open by the increaſed preſſure of the outward cold air endeavouring to get in to ſupply the place of the warm air, that now paſſes out of the room to go up the chimney. In our common open chimneys, half the fuel is waſted, and its effect loſt; the air it has warmed being immediately drawn off. Several of my acquaintance having ſeen this ſimple machine in my room, have imitated it at their own houſes, and it ſeems likely to become pretty common. I deſcribe it thus particularly to you, becauſe I think it would be uſeful in *Boſton*, where firing is often dear.

Mentioning

Mentioning chimneys puts me in mind of a property I formerly had occaſion to obſerve in them, which I have not found taken notice of by others; it is, that in the ſummer-time, when no fire is made in the chimneys, there is, nevertheleſs, a regular draught of air through them; continually paſſing upwards, from about five or ſix o'clock in the afternoon, till eight or nine o'clock the next morning, when the current begins to ſlacken and heſitate a little, for about half an hour, and then ſets as ſtrongly down again, which it continues to do till towards five in the afternoon, then ſlackens and heſitates as before, going ſometimes a little up, then a little down, till in about half an hour it gets a ſteady upward current for the night, which continues till eight or nine the next day; the hours varying a little as the days lengthen and ſhorten, and ſometimes varying from ſudden changes in the weather; as if, after being long warm, it ſhould begin to grow cool about noon, while the air was coming down the chimney, the current will then change earlier than the uſual hour, *&c.*

This property in chimneys I imagine we might turn to ſome account, and render improper, for the future, the old ſaying, *as uſeleſs as a chimney in ſummer.* If the opening of the chimney, from the breaſt down to the hearth, be cloſed by a ſlight moveable frame or two, in the manner of doors, covered with canvas, that will let the air through, but keep out

the flies; and another little frame ſet within upon the hearth, with hooks on which to hang joints of meat, fowls, &c. wrapt well in wet linen cloths, three or four fold, I am confident that if the linen is kept wet, by ſprinkling it once a day, the meat would be ſo cooled by the evaporation, carried on continually by means of the paſſing air, that it would keep a week or more in the hotteſt weather. Butter and milk might likewiſe be kept cool, in veſſels or bottles covered with wet cloths. A ſhallow tray, or keeler, ſhould be under the frame to receive any water that might drip from the wetted cloths. I think, too, that this property of chimneys might, by means of ſmoke-jack vanes, be applied to ſome mechanical purpoſes, where a ſmall but pretty conſtant power only is wanted.

If you would have my opinion of the cauſe of this changing current of air in chimneys, it is, in ſhort, as follows. In ſummer-time there is generally a great difference in the warmth of the air at mid-day and mid-night, and, of courſe, a difference of ſpecific gravity in the air, as the more it is warmed the more it is rarefied. The funnel of a chimney being for the moſt part ſurrounded by the houſe, is protected, in a great meaſure, from the direct action of the ſun's rays, and alſo from the coldneſs of the night air. It thence preſerves a middle temperature between the heat of the day, and the coldneſs of the night. This middle

middle temperature it communicates to the air contained in it. If the ſtate of the outward air be cooler than that in the funnel of the chimney, it will, by being heavier, force it to riſe, and go out at the top. What ſupplies its place from below, being warmed, in its turn, by the warmer funnel, is likewiſe forced up by the colder and weightier air below, and ſo the current is continued till the next day, when the ſun gradually changes the ſtate of the outward air, makes it firſt warm as the funnel of the chimney can make it (when the current begins to heſitate) and afterwards warmer. Then the funnel being cooler than the air that comes into it, cools that air, makes it heavier than the outward air, of courſe it deſcends; and what ſucceeds it from above, being cooled in its turn, the deſcending current continues till towards evening, when it again heſitates and changes its courſe, from the change of warmth in the outward air, and the nearly remaining ſame middle temperature in the funnel.

Upon this principle, if a houſe were built behind *Beacon-hill*, an adit carried from one of the doors into the hill horizontally, till it met with a perpendicular ſhaft ſunk from its top, it ſeems probable to me, that thoſe who lived in the houſe, would conſtantly, in the heat even of the calmeſt day, have as much cool air paſſing through the houſe, as they ſhould chuſe; and the ſame, though reverſed in its current, during the ſtilleſt night.

I think,

I think, too, this property might be made of uſe to miners; as where ſeveral ſhafts or pits are ſunk perpendicularly into the earth communicating at bottom by horizontal paſſages, which is a common caſe, if a chimney of thirty or forty feet high were built over one of the ſhafts, or ſo near the ſhaft, that the chimney might communicate with the top of the ſhaft, all air being excluded but what ſhould paſs up or down by the ſhaft, a conſtant change of air would, by this means, be produced in the paſſages below, tending to ſecure the workmen from thoſe damps which ſo frequently incommode them: for the freſh air would be almoſt always going down the open ſhaft to go up the chimney, or down the chimney to go up the ſhaft. Let me add one obſervation more, which is, that if that part of the funnel of a chimney, which appears above the roof of a houſe, be pretty long, and have three of its ſides expoſed to the heat of the ſun ſucceſſively, viz. when he is in the eaſt, in the ſouth, and in the weſt, while the north ſide is ſheltered by the building from the cold northerly winds; ſuch a chimney will often be ſo heated by the ſun, as to continue the draught ſtrongly upwards, through the whole twenty-four hours, and often for many days together. If the outſide of ſuch a chimney be painted black, the effect will be ſtill greater, and the current ſtronger.

N° III.

N° III.

IT is ſaid the northern Chineſe have a method of warming their ground-floors, which is ingenious. Thoſe floors are made of tile a foot ſquare and two inches thick, their corners being ſupported by bricks ſet on end, that are a foot long and four inches ſquare; the tiles, too, join into each other, by ridges and hollows along their ſides. This forms a hollow under the whole floor, which on one ſide of the houſe has an opening into the air, where a fire is made, and it has a funnel riſing from the other ſide to carry off the ſmoke. The fuel is a ſulphureous pitcoal, the ſmell of which in the room is thus avoided, while the floor, and of courſe the room, is well warmed. But as the under ſide of the floor muſt grow foul with ſoot, and a thick coat of ſoot prevents much of the direct application of the hot air to the tiles, I conceive that burning the ſmoke, by obliging it to deſcend through red coals, would in this conſtruction be very advantageous, as more heat would be given by the flame than by the ſmoke, and the floor being thereby kept free from ſoot, would be more heated with leſs fire. For this purpoſe I would propoſe erecting the funnel cloſe to the grate, ſo as to have only an iron plate between the fire and the funnel, through which plate the air in the funnel being heated,

it

it will be ſure to draw well, and force the ſmoke to deſcend, as in the figure, where A is the funnel or chimney, B the grate on which the fire is placed, C one of the apertures through which the deſcending ſmoke is drawn into the channel D of figure 10, along which channel it is conveyed by a circuitous rout, as deſignated by the arrows, until it arrives at the ſmall aperture E, figure 10, through which it enters the funnel F. G in both figures is the iron plate againſt which the fire is made, which being heated thereby, will rarefy the air in that part of the funnel, and cauſe the ſmoke to aſcend rapidly. The flame thus dividing from the grate to the right and left, and turning in paſſages diſpoſed, as in figure 13, ſo as that every part of the floor may be viſited by it before it enters the funnel F, by the two paſſages E E, very little of the heat will be loſt, and a winter room thus rendered very comfortable.

Plate I. Figure 9.

N° IV.

PAGE 12. *Few can imagine*, &c. It is ſaid the Icelanders have very little fuel, chiefly drift wood that comes upon their coaſt. To receive more advantage from its heat, they make their doors low, and have a ſtage round the room above the door, like a gallery, wherein the women can ſit and work, the men read or write, &c. The roof being tight, the warm air

is

is confined by it, and kept from riſing higher and eſcaping; and the cold air, which enters the houſe when the door is opened, cannot riſe above the level of the top of the door, becauſe it is heavier than the warm air above the door, and ſo thoſe in the gallery are not incommoded by it. Some of our too lofty rooms might have a ſtage ſo conſtructed as to make a temporary gallery above, for the winter, to be taken away in ſummer. Sedentary people would find much comfort there in cold weather.

N° V.

PAGE 37. *Where they have the art of managing it*, &c. In ſome houſes of the lower people among the northern nations of Europe, and among the poorer ſort of Germans in Pennſylvania, I have obſerved this conſtruction, which appears very advantageous. A is the kitchen with its chimney; B an iron ſtove in the ſtove-room. In a corner of the chimney is a hole through the back into the ſtove, to put in fuel, and another hole above it to let the ſmoke of the ſtove come back into the chimney. As ſoon as the cooking is over, the brands in the kitchen chimney are put through the hole to ſupply the ſtove, ſo that there is ſeldom more than one fire burning at a time. In the floor over the ſtove-room is a ſmall trap-door, to let the warm air riſe occaſionally into the chamber. Thus the whole houſe

Plate I. Fig. 11.

is

is warmed at little expence of wood, and the ſtove-room kept conſtantly warm; ſo that in the coldeſt winter nights, they can work late, and find the room ſtill comfortable when they riſe to work early. An Engliſh farmer in America, who makes great fires in large open chimneys, needs the conſtant employment of one man to cut and haul wood for ſupplying them; and the draught of cold air to them is ſo ſtrong, that the heels of his family are frozen while they are ſcorching their faces, and the room is never warm, ſo that little ſedentary work can be done by them in winter. The difference in this article alone of œconomy ſhall, in a courſe of years, enable the German to buy out the Engliſhman, and take poſſeſſion of his plantation.

MISCELLANEOUS OBSERVATIONS.

CHIMNEYS whoſe funnels go up in the north wall of a houſe, and are expoſed to the north winds, are not ſo apt to draw well as thoſe in a ſouth wall; becauſe when rendered cold by thoſe winds, they draw downwards.

Chimneys encloſed in the body of a houſe are better than thoſe whoſe funnels are expoſed in cold walls.

Chimneys in ſtacks are apt to draw better than ſeparate funnels, becauſe the funnels that have conſtant fires in them, warm the others in ſome degree that have none.

One of the funnels in a houſe I once occu-

pied, had a particular funnel joined to the ſouth ſide of the ſtack, ſo that three of its ſides were expoſed to the ſun in the courſe of the day, viz. the eaſt ſide E during the morning, the ſouth ſide S in the middle part of the day, and the weſt ſide W during the afternoon, while its north ſide was ſheltered by the ſtack from the cold winds. This funnel, which came from the ground floor, and had a conſiderable height above the roof, was conſtantly in a ſtrong drawing ſtate day and night, winter and ſummer.

Plate I. Figure 12.

Blacking of funnels expoſed to the ſun, would probably make them draw ſtill ſtronger.

In Paris I ſaw a fire-place ſo ingeniouſly contrived as to ſerve conveniently two rooms, a bedchamber and a ſtudy. The funnel over the fire was round. The fire-place was of caſt iron, having an upright back A, and two horizontal ſemicircular plates B C, the whole ſo ordered as to turn on the pivots D E. The plate B always ſtopped that part of the round funnel that was next to the room without fire, while the other half of the funnel over the fire was always open. By this means a ſervant in the morning could make a fire on the hearth C, then in the ſtudy, without diſturbing the maſter by going into his chamber; and the maſter when he roſe, could with a touch of his foot turn the chimney on its pivots, and bring the fire into his chamber, keep it there as long as he wanted it,

Plate I. Figure 13.

and turn it again when he went out into his ſtudy. The room which had no fire in it, was alſo warmed by the heat coming through the back plate, and ſpreading in the room, as it could not go up the chimney.

To His Excellency BENJAMIN FRANKLIN, *Eſq. L. L. D. Preſident of the State of Pennſylvania, and of the American Philoſophical Society, &c.*

SIR, Philadelphia, January 12, 1786.

THE ſubject of ſmoky chimneys, of which I had the honour of converſing with you at your own houſe laſt evening, is of ſo much importance to every individual, as well as to every private family, that too much light cannot be thrown upon it.

A ſmoky houſe and a ſcolding wife,
Are (ſaid to be) two of the greateſt ills in life.

And however difficult it may be to remedy one of thoſe ills, yet any advances we may be able to make towards removing the inconveniences ariſing from the other, cannot fail to be favourably received by the public. As they are ſhortly to be favoured with your ſentiments on that ſubject, poſſibly the following obſervations, which were in fact occaſioned by neceſſity, and are the reſult of my own experience, may not be altogether undeſerving of notice.

When I left London and went to live in Devonſhire, in the latter end of the year 1777, it happened to be my lot to dwell in an old manſion which had been recently moderniſed, and had undergone a thorough repair. But as in moſt of the old houſes in England, the chimneys, which were perhaps originally built for the purpoſe of burning wood, though they had been contracted in front, ſince coal fires came into general uſe, to the modern ſize, yet they were ſtill, above, out of ſight, extravagantly large. This method of building chimneys may perhaps have anſwered well enough while it was the cuſtom to ſit with the doors and windows open; but when the cuſtoms and manners of the people began to be more poliſhed and refined, when building and architecture were improved, and they began to conceive the idea of making their chambers cloſe, warm, and comfortable, theſe chimneys were found to ſmoke abominably, for want of a ſufficient ſupply of air. This was exactly the caſe with the houſe in which I firſt lived, near Exeter, and I was under the neceſſity of trying every expedient I could think of to make it habitable.

The firſt thing I tried, was that method of contracting the chimneys by means of earthen pots, much in uſe in England, which are made on purpoſe, and which are put upon the tops of them; but this method by no means anſwered. I then thought of contracting them below, but as the method of contracting them

in

in front to the ſize of a ſmall coal-fire grate has an unſightly appearance, as it makes a diſagreeable blowing like a furnace, and as it is the occaſion of conſuming a great deal of unneceſſary fuel, the heat of which is immediately hurried up the chimney, I rejected this method, and determined to contract them above, a little out of ſight. For this purpoſe I threw an arch acroſs, and alſo drew them in at the ſides. This had ſome effect, but as this contraction was made rather ſuddenly, and the ſmoke, by ſtriking againſt the corners that were thereby occaſioned, was apt to recoil, by which means ſome part of it was thrown out into the room; I determined to make the contraction more gradually, and therefore run it up at the back, where the depth of the chimney would admit of it, and alſo ſhelving or ſloping in a conical kind of direction at the ſides, as high as a man, ſtanding upright, could conveniently reach, and by this means brought the cavity within the ſpace of about twelve by fourteen or ſixteen inches, which I found ſufficiently large to admit a boy to go up and down to ſweep the chimneys. This method I found to ſucceed perfectly well, as to curing the chimneys of ſmoking, and it had this good effect, of making the rooms conſiderably warmer; and as this experiment ſucceeded ſo well, ſince the only uſe of a chimney is to convey away the ſmoke, I determined to carry it ſtill farther, in order to aſcertain, with preciſion, how much

ſpace is abſolutely neceſſary for that purpoſe, becauſe all the reſt that is ſhut up muſt be ſo much gained in warmth. Accordingly I laid a piece of ſlate acroſs the remaining aperture, removable at pleaſure, ſo as to contract the ſpace above two thirds, leaving about three inches by twelve remaining open; but this ſpace, except when the fire burnt remarkably clear, was ſcarcely ſufficient to carry away the ſmoke. I therefore enlarged it to half the ſpace, that is, to about ſix by ſeven or eight inches, which I found fully ſufficient to carry away the ſmoke from the largeſt fires.

When I removed into the Bedford Circus in Exeter, though the houſe was modern, and almoſt perfectly new, yet the chimneys were large; in conſequence of which almoſt every room of it ſmoked. My predeceſſor, who was the firſt inhabitant, had been at great expence in patent ſtoves, &c. but without effect; but by adopting the method I have juſt now deſcribed, I not only cured every chimney of ſmoking, but my houſe was remarked for being one of the warmeſt and moſt comfortable to live in of any in that large and opulent city.

The houſe I now live in, in Philadelphia, I am told, has always had the character of being both cold and ſmoky; and I was convinced, as ſoon as I ſaw the rooms and examined the chimneys, that it deſerved that character; for though the rooms were cloſe, the chimneys were large; and we ſhall ever find, that if

our

our chimneys are large, our rooms will be cold, even though they ſhould be tolerably cloſe and tight; becauſe the conſtant ruſhing in of the cold air at the cracks and crevices, and alſo at every opening of the door, will be ſufficient to chill the air, as faſt as it is heated, or to force the heated air up the chimney; but by contracting the chimneys I have cured it of both theſe defects. There was one remarkable circumſtance attending the contraction of the chimney in the front parlour, which deſerves to be attended to; which was, that before I applied the caſt iron plate, which I made uſe of inſtead of ſlate, to diminiſh the ſpace requiſite for a chimney-ſweeper's boy to go up and down, the ſuction or draught of air was ſo great, that it was with difficulty I could ſhut the door of the room, inſomuch that I at firſt thought it was owing to a tightneſs of the hinges, which I imagined muſt be remedied; but upon applying the iron plate, by which the ſpace was diminiſhed one half, the door ſhut to with the greateſt eaſe. This extraordinary preſſure of the air upon the door of the room, or ſuction of the chimney, I take to be owing in ſome meaſure to the unuſual height of the houſe.

Upon the whole, therefore, this fact ſeems clearly aſcertained, viz. That the flue or ſize of the chimney ought always to be proportioned to the tightneſs and cloſeneſs of the room: ſome air is undoubtedly neceſſary to be

admitted into the room in order to carry up the ſmoke, otherwiſe, as you juſtly obſerved, we might as well expect ſmoke to ariſe out of an exhauſted receiver; but if the flue is very large, either the room is tight, and the ſmoke will not aſcend, or it is pretty open, and the conſequence will be, that the air of your room will be ſo frequently and ſo conſtantly changed, that as faſt as it is heated, it will be hurried away, with the ſmoke, up the chimney, and of courſe your room will be conſtantly cold.

One great advantage attending this method of curing ſmoky chimneys is, that, in the firſt place, it makes no awkward or unſightly appearance, nothing being to be ſeen but what is uſual to chimneys in common; and, in the ſecond place, that it is attended with very little expence, a few bricks and mortar, with a plate or covering to the aperture, and a little labour, being all that is requiſite. But in this new country, where crops of houſes may be expected to riſe almoſt as quick as fields of corn, when the principles upon which chimneys ſhould be erected ought to be thoroughly underſtood, it is to be hoped, that not only this expence, ſmall as it is, but that all the other inconveniences we have been ſpeaking of, will be avoided, by conſtructing the flues of the chimneys ſufficiently ſmall.

From your humble ſervant,

THOMAS RUSTON.

Deſcription

Deſcription of a new STOVE *for burning of Pitcoal, and conſuming all its Smoke.*

BY DR. B. FRANKLIN.

TOWARDS the end of the laſt century an ingenious French philoſopher, whoſe name I am ſorry I cannot recollect, exhibited an experiment to ſhow that very offenſive things might be burnt in the middle of a chamber, ſuch as woollen rags, feathers, &c. without creating the leaſt ſmoke or ſmell. The machine in which the experiment was made, if I remember right, was of this form, made of plate iron. Some clear-burning charcoals were put into the opening of the ſhort tube A, and ſupported there by the grate B. The air, as ſoon as the tubes grew warm, would aſcend in the longer leg C, and go out at D, conſequently air muſt enter at A deſcending to B. In this courſe it muſt be heated by the burning coals through which it paſſed, and riſe more forcibly in the longer tube, in proportion to its degree of heat or rarefaction, and length of that tube. For ſuch a machine is a kind of inverted ſyphon: and as the greater weight of water in the longer leg of a common ſyphon, in deſcending, is accompanied by an aſcent of the ſame fluid in the ſhorter; ſo, in this inverted ſyphon, the greater quantity of levity of air in the longer leg, in riſing, is ac-

Plate II. Figure 1.

companied by the deſcent of air in the ſhorter. The things to be burned being laid on the hot coals at A, the ſmoke muſt deſcend through thoſe coals, and be converted into flame, which, after deſtroying the offenſive ſmell, comes out at the end of the longer tube as mere heated air.

Whoever would repeat this experiment with ſucceſs, muſt take care that the part A, B, of the ſhort tube be quite full of burning coals, ſo that no part of the ſmoke may deſcend and paſs by them without going through them, and being converted into flame; and that the longer tube be ſo heated as that the current of aſcending hot air is eſtabliſhed in it before the things to be burnt are laid on the coals; otherwiſe there will be a diſappointment.

It does not appear, either in the Memoirs of the Academy of Sciences, or Philoſophical Tranſactions of the Engliſh Royal Society, that any improvement was ever made of this ingenious experiment, by applying it to uſeful purpoſes. But there is a German book, entitled *Vulcanus Famulans*, by Joh. George Leutmann, P. D. printed at Wirtemberg in 1723, which deſcribes, among a great variety of other ſtoves for warming rooms, one which ſeems to have been formed on the ſame principle, and probably from the hint thereby given, though the French experiment is not mentioned. This book being ſcarce, I have tranſlated the chapter deſcribing the ſtove, viz.

" Vulcanus

Fig. 1.

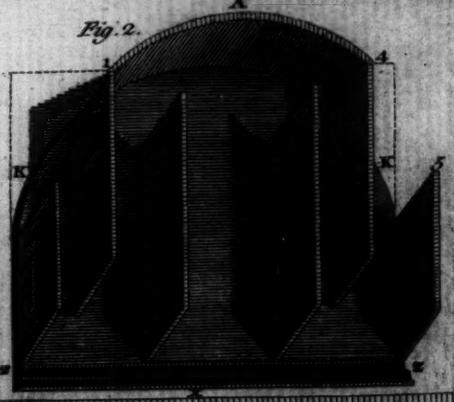


Fig. 2.

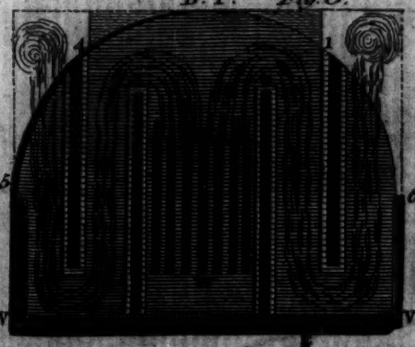
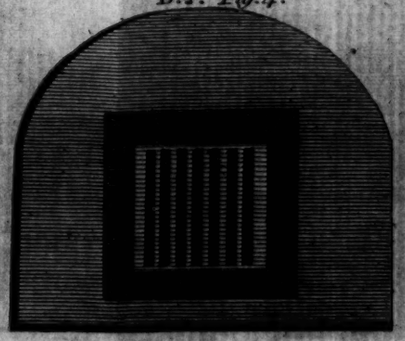


Fig. 3.



B. 2. Fig. 4.

Fig. 5.

Fig. 6.

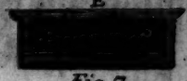


Fig. 7.

Fig. 8.

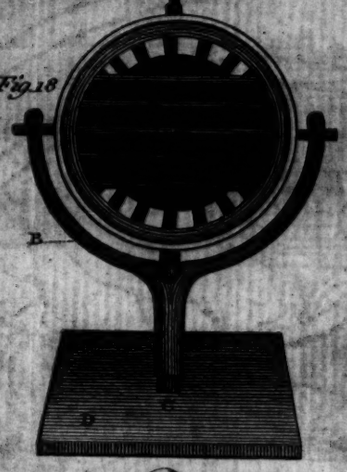
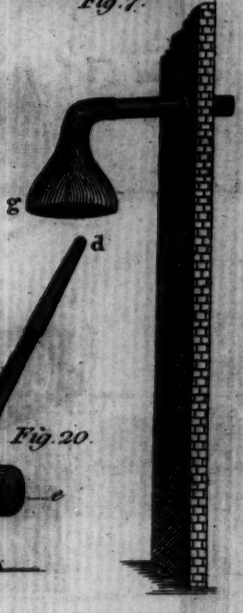


Fig. 18.

Fig. 19.



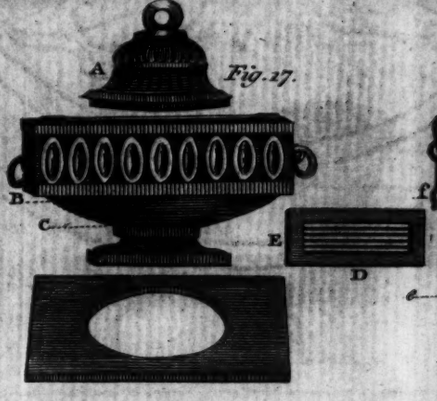


Fig. 17.

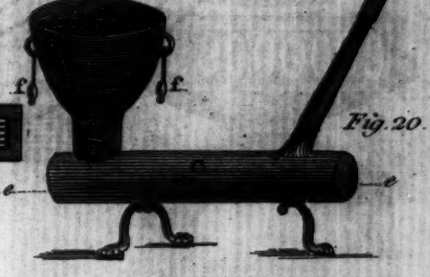


Fig. 20.

Fig. 9.

Fig. 10.

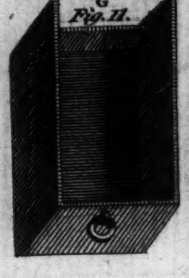


Fig. 11.

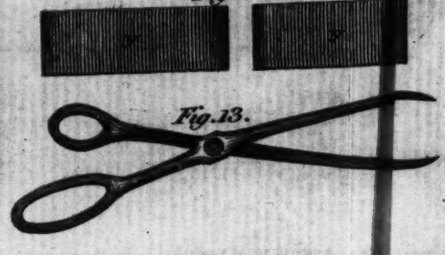


Fig. 12.

Fig. 13.

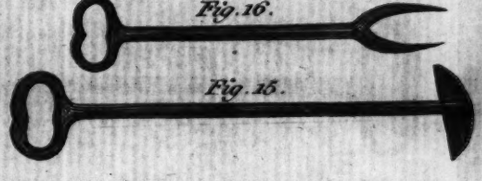


Fig. 16.

Fig. 15.

Fig. 14.

" Vulcanus Famulans, by John George Leutmann, P. D. Wirtemberg, 1723.

" CHAP. VII.

" On a ſtove, which draws downwards.

" Here follows the deſcription of a ſort of " ſtove, which can eaſily be removed, and again " replaced, at pleaſure. This drives the fire " down under itſelf, and gives no ſmoke, but " however a very unwholeſome vapour.

" In the figure, A is an iron veſſel like a " funnel, in diameter at the top about " twelve inches, at the bottom near the Plate II. Figure 20. " grate about five inches; its height " twelve inches. This is ſet on the barrel C, " which is ten inches diameter and two feet " long, cloſed at each end E E. From one " end riſes a pipe or flue about four inches " diameter, on which other pieces of pipe are " ſet, which are gradually contracted to D, " where the opening is but about two inches. " Thoſe pipes muſt together be at leaſt four " feet high. B is an iron grate. F F are iron " handles guarded with wood, by which the " ſtove is to be lifted and moved. It ſtands " on three legs. Care muſt be taken to ſtop " well all the joints, that no ſmoke may leak " through.

" When this ſtove is to be uſed, it muſt firſt " be carried into the kitchen, and placed in

" the

" the chimney near the fire. There burning " wood muſt be laid and left upon its grate " till the barrel C is warm, and the ſmoke no " longer riſes at A, but deſcends towards C. " Then it is to be carried into the room which " it is to warm. When once the barrel C is " warm, freſh wood may be thrown into the " veſſel A as often as one pleaſes; the flame " deſcends and without ſmoke, which is ſo " conſumed that only a vapour paſſes out at D.

" As this vapour is unwholeſome, and af- " fects the head, one may be freed from it, by " fixing in the wall of the room an inverted " funnel, ſuch as people uſe to hang over " lamps, through which their ſmoke goes out " as through a chimney. This funnel carries " out all the vapour cleverly, ſo that one finds " no inconvenience from it, even though the " opening D be placed a ſpan below the mouth " of the ſaid funnel G. The neck of the fun- " nel is better when made gradually bending, " than if turned in a right angle.

" The cauſe of the draught downwards in " the ſtove is the preſſure of the outward air, " which falling into the veſſel A in a column " of twelve inches diameter, finds only a re- " ſiſting paſſage at the grate B, of five inches, " and one at D, of two inches, which are much " too weak to drive it back again; beſides, A " ſtands much higher than B, and ſo the preſ- " ſure on it is greater and more forcible, and " beats down the flame to that part where it

" finds

" finds the leaſt reſiſtance. Carrying the ma-
" chine firſt to the kitchen fire for prepara-
" tion, is on this account, that in the begin-
" ning the fire and ſmoke naturally aſcend,
" till the air in the cloſe barrel C is made
" thinner by the warmth. When that veſſel
" is heated, the air in it is rarefied, and then
" all the ſmoke and fire deſcends under it.

" The wood ſhould be thoroughly dry, and
" cut into pieces five or ſix inches long, to fit
" it for being thrown into the funnel A." Thus far the German book.

It appears to me by Mr. Leutmann's explanation of the operation of this machine, that he did not underſtand the principles of it, whence I conclude he was not the inventor of it; and by the deſcription of it, wherein the opening at A is made ſo large, and the pipe E, D, ſo ſhort, I am perſuaded he never made nor ſaw the experiment; for the firſt ought to be much ſmaller, and the laſt much higher, or it hardly will ſucceed. The carrying it in the kitchen, too, every time the fire ſhould happen to be out, muſt be ſo troubleſome, that it is not likely ever to have been in practice, and probably has never been ſhown but as a philoſophical experiment. The funnel for conveying the vapour out of the room would beſides have been uncertain in its operation, as a wind blowing againſt its mouth would drive the vapour back.

The ſtove I am about to deſcribe, was alſo formed on the idea given by the French experiment,

riment, and completely carried into execution before I had any knowledge of the German invention; which I wonder ſhould remain ſo many years in a country where men are ſo ingenious in the management of fire, without receiving long ſince the improvements I have given it.

DESCRIPTION of the PARTS.

A, the bottom plate, which lies flat upon the hearth, with its partitions 1, 2, 3, 4, 5, 6, that are caſt with it, and a groove Z Z, in which are to ſlide the bottomedges of the ſmall plates Y, Y, figure 12; which plates meeting at X cloſe the front.

Plate II. Figure 2.

B 1, figure 3, is the cover plate ſhowing its under ſide, with the grooves 1, 2, 3, 4, 5, 6, to receive the top edges of the partitions that are fixed to the bottom plate. It ſhows alſo the grate W W, the bars of which are caſt in the plate, and a groove V V, which comes right over the groove Z Z, figure 2, receiving the upper edges of the ſmall ſliding plates Y Y, figure 12.

B 2, figure 4, ſhows the upper ſide of the ſame plate, with a ſquare impreſſion or groove for receiving the bottom mouldings T T T T of the three-ſided box C, figure 5, which is caſt in one piece.

D, figure 6, its cover, ſhowing its under ſide with grooves to receive the upper edges S S S of the ſides of C, figure 5; alſo a groove R, R,

R, R, which when the cover is put on come right over another Q Q in C, figure 5, between which it is to ſlide.

E, figure 7, the front plate of the box.

P, a hole three inches diameter through the cover D, figure 6, over which hole ſtands the vaſe F, figure 8, which has a correſponding hole two inches diameter through its bottom.

The top of the vaſe opens at O, O, O, figure 8, and turns back upon a hinge behind when coals are to be put in; the vaſe has a grate within at N N of caſt iron H, figure 9, and a hole in the top one inch and a half diameter to admit air, and to receive the ornamental braſs gilt flame M, figure 10, which ſtands in that hole, and, being itſelf hollow and open, ſuffers air to paſs through it to the fire.

G, figure 11, is a drawer of plate iron, that ſlips in between in the partitions 2 and 3, figure 2, to receive the falling aſhes. It is concealed when the ſmall ſliding plates Y Y, figure 12, are ſhut together.

I, I, I, I, figure 8, is a niche built of brick in the chimney and plaſtered. It cloſes the chimney over the vaſe, but leaves two funnels, one in each corner, communicating with the bottom box K K, figure 2.

DIMENSIONS of the PARTS.

	Feet.	In.
Front of the bottom box, - -	2	0
Height of its partitions, - - -	0	4½

Length

	Feet.	In.
Length of N° 1, 2, 3, and 4, each, -	1	3
Length of N° 5 and 6, each, - -	0	8¼
Breadth of the paſſage between N° 2 and 3, - - - - - - -	0	6
Breadth of the other paſſages, each,	0	3½
Breadth of the grate, - - - - -	0	6½
Length of ditto, - - - - - -	0	8
Bottom moulding of box C, ſquare,	1	0
Height of the ſides of ditto, - -	0	4
Length of the back ſide, - -	0	10
Length of the right and left ſides, each, - - - - - - - - - -	0	9½
Length of the front plate E, where longeſt, - - - - - - - - -	0	11
The cover D, ſquare, - - -	0	12
Hole in ditto, diameter, - - -	0	3
Sliding plates Y Y, their length each, - - - - - - - -	1	0
———————— their breadth each, - - - - - - - -	0	4½
Drawer G, its length, - - -	1	0
———————— breadth, - - -	0	5¾
———————— depth, - - - -	0	4
———————— depth of its further end, only, - - - - - -	0	1
Grate H in the vaſe, its diameter to the extremity of its knobs, -	0	5¾
Thickneſs of the bars at top, - -	0	0¼
———————— at bottom, leſs, - - - - - - - -	0	0
Depth of the bars at the top, -	0	0¾

Height

	Feet.	In.
Height of the vaſe, - - - - -	1	6
Diameter of the opening O, O, in the clear, - - - - -	0	8
——— of the air-hole at top, -	0	1½
——— of the flame-hole at bottom, - - - - - -	0	2

To fix this Machine.

Spread mortar on the hearth to bed the bottom plate A, then lay that plate, level, equally diſtant from each jamb, and projecting out as far as you think proper. Then putting ſome Windſor loam in the grooves of the cover B, lay that on: trying the ſliding plates Y Y, to ſee if they move freely in the grooves Z Z, V V, deſigned for them.

Then begin to build the niche, obſerving to leave the ſquare corners of the chimney unfilled; for they are to be funnels. And obſerve alſo to leave a free open communication between the paſſages at K K, and the bottom of thoſe funnels, and mind to cloſe the chimney above the top of the niche, that no air may paſs up that way. The concave back of the niche will reſt on the circular iron partition 1 A 4, figure 2; then with a little loam put on the box C over the grate, the open ſide of the box in front.

Then, with loam in three of its grooves, the groove R R being left clean, and brought directly over the groove Q Q in the box, put

on the cover D, trying the front plate E, to ſee if it ſlides freely in thoſe grooves.

Laſtly, ſet on the vaſe, which has ſmall holes in the moulding of its bottom to receive two iron pins that riſe out of the plate D at I I, for the better keeping it ſteady.

Then putting in the grate H, which reſts on its three knobs H H H againſt the inſide of the vaſe, and ſlipping the drawer into its place; the machine is fit for uſe.

To uſe it.

Let the firſt fire be made after eight in the evening, or before eight in the morning, for at thoſe times and between thoſe hours all night, there is uſually a draft up a chimney, though it has long been without fire; but between thoſe hours in the day there is often in a cold chimney a draft downwards, when, if you attempt to kindle a fire, the ſmoke will come into the room.

But to be certain of your proper time, hold a flame over the air-hole at the top. If the flame is drawn ſtrongly down for a continuance, without whiffling, you may begin to kindle a fire.

Firſt put in a few charcoals on the grate H.
Lay ſome ſmall ſticks on the charcoals,
Lay ſome pieces of paper on the ſticks,
Kindle the paper with a candle,
Then ſhut down the top, and the air will paſs down through the air-hole: blow the flame

flame of the paper down through the ſticks, kindle them, and their flame paſſing lower, kindles the charcoal.

When the charcoal is well kindled, lay on it the ſea-coals, obſerving not to choak the fire by putting on too much at firſt.

The flame deſcending through the hole in the bottom of the vaſe, and that in plate D into the box C, paſſes down farther through the grate W W in plate B 1, then paſſes horizontally towards the back of the chimney; there dividing, and turning to the right and left, one part of it paſſes round the far end of the partition 2, then coming forward, it turns round the near end of partition 1, then moving backward, it arrives at the opening into the bottom of one of the upright corner funnels behind the niche, through which it aſcends into the chimney, thus heating that half of the box and that ſide of the niche. The other part of the divided flame paſſes round the far end of partition 3, round the near end of partition 4, and ſo into and up the other corner funnel, thus heating the other half of the box, and the other ſide of the niche. The vaſe itſelf, and the box C, will alſo be very hot, and the air ſurrounding them being heated, and riſing, as it cannot get into the chimney, it ſpreads in the room; colder air ſucceeding is warmed in its turn, riſes and ſpreads, till by the continual circulation the whole is warmed.

If you ſhould have occaſion to make your

firſt fire at hours not ſo convenient as thoſe above mentioned, and when the chimney does not draw, do not begin it in the vaſe, but in one or more of the paſſages of the lower plate, firſt covering the mouth of the vaſe. After the chimney has drawn a while with the fire thus low, and begins to be a little warm, you may cloſe thoſe paſſages, and kindle another fire in the box C, leaving its ſliding ſhutter a little open; and when you find after ſome time that the chimney being warmed draws forcibly, you may ſhut that paſſage, open your vaſe, and kindle your fire there, as above directed. The chimney well warmed by the firſt day's fire will continue to draw conſtantly all winter, if fires are made daily.

You will, in the management of your fire, have need of the following implements:

A pair of ſmall light tongs, twelve or fifteen inches long, plate II. figure 13.

A light poker about the ſame length, with a flat broad point, figure 14.

A rake to draw aſhes out of the paſſages of the lower plate, where the lighter kind eſcaping the aſh-box, will gather by degrees, and perhaps once in a week or ten days require being removed, figure 15.

And a fork, with its prongs wide enough to ſlip on the neck of the vaſe cover, in order to raiſe and open it when hot, to put in freſh coals, figure 16.

In the management of this ſtove there are certain

certain precautions to be obſerved, at firſt with attention, till they become habitual. To avoid the inconvenience of ſmoke, ſee that the grate H be clear before you begin to light a freſh fire. If you find it clogged with cinders and aſhes, turn it up with your tongs, and let them fall upon the grate below; the aſhes will go through it, and the cinders may be raked off and returned into the vaſe when you would burn them. Then ſee that all the ſliding plates are in their places and cloſe ſhut, that no air may enter the ſtove but through the round opening at the top of the vaſe. And, to avoid the inconvenience of duſt from the aſhes, let the aſh-drawer be taken out of the room to be emptied; and when you rake the paſſages, do it when the draft of the air is ſtrong inwards, and put the aſhes carefully into the aſh-box, that remaining in its place.

If being about to go abroad, you would prevent your fire burning in your abſence, you may do it by taking the braſs flame from the top of the vaſe, and covering the paſſage with a round tin plate, which will prevent the entry of more air than barely ſufficient to keep a few of the coals alive. When you return, though ſome hours abſent, by taking off the tin plate, and admitting the air, your fire will ſoon be recovered.

The effect of this machine, well managed, is to burn not only the coals, but all the ſmoke of the coals, ſo that while the fire is burning,

if you go out and obſerve the top of your chimney, you will ſee no ſmoke iſſuing, nor any thing but clear warm air, which, as uſual, makes the bodies ſeen through it appear waving.

But let none imagine from this, that it may be a cure for bad or ſmoky chimneys, much leſs that, as it burns the ſmoke, it may be uſed in a room that has no chimney. It is by the help of a good chimney, the higher the better, that it produces its effect; and though a flue of plate iron ſufficiently high might be raiſed in a very lofty room, the management to prevent all diſagreeable vapour would be too nice for common practice, and ſmall errors would have unpleaſing conſequences.

It is certain that clean iron yields no offenſive ſmell when heated. Whatever of that kind you perceive, where there are iron ſtoves, proceeds therefore from ſome foulneſs burning or fuming on their ſurface. They ſhould therefore never be ſpit upon, or greaſed, nor ſhould any duſt be ſuffered to lie upon them. But as the greateſt care will not always prevent theſe things, it is well once a week to waſh the ſtove with ſoap lees and a bruſh, rinſing it with clean water.

The Advantages of this Stove.

1. The chimney does not grow foul, nor ever need ſweeping; for as no ſmoke enters it, no ſoot can form in it.

2. The

2. The air heated over common fires inſtantly quits the room, and goes up the chimney with the ſmoke; but in the ſtove, it is obliged to deſcend in flame, and paſs through the long winding horizontal paſſages, communicating its heat to a body of iron plate, which having thus time to receive the heat, communicates the ſame to the air of the room, and thereby warms it to a greater degree.

3. The whole of the fuel is conſumed by being turned into flame, and you have the benefit of its heat; whereas in common chimneys a great part goes away in ſmoke, which you ſee as it riſes, but it affords you no rays of warmth. One may obtain ſome notion of the quantity of fuel thus waſted in ſmoke, by reflecting on the quantity of ſoot that a few weeks firing will lodge againſt the ſides of the chimney, and yet this is formed only of thoſe particles of the column of ſmoke that happen to touch the ſides in its aſcent. How much more muſt have paſſed off in the air? And we know that this ſoot is ſtill fuel; for it will burn and flame as ſuch, and when hard caked together is indeed very like, and almoſt as ſolid as the coal it proceeds from. The deſtruction of your fuel goes on nearly in the ſame quantity whether in ſmoke or in flame: but there is no compariſon in the difference of heat given. Obſerve when freſh coals are firſt put on your fire, what a body of ſmoke ariſes. This ſmoke is for a long time too cold to take flame. If you then plunge a burning

candle into it, the candle inſtead of inflaming the ſmoke, will inſtantly be itſelf extinguiſhed. Smoke muſt have a certain degree of heat to be inflammable. As ſoon as it has acquired that degree, the approach of a candle will inflame the whole body, and you will be very ſenſible of the difference of the heat it gives. A ſtill eaſier experiment may be made with the candle itſelf. Hold your hand near the ſide of its flame, and obſerve the heat it gives; then blow it out, the hand remaining in the ſame place, and obſerve what heat may be given by the ſmoke that riſes from the ſtill burning ſnuff. You will find it very little. And yet that ſmoke has in it the ſubſtance of ſo much flame, and will inſtantly produce it, if you hold another candle above it ſo as to kindle it. Now the ſmoke from the freſh coals laid on this ſtove, inſtead of aſcending and leaving the fire while too cold to burn, being obliged to deſcend through the burning coals, receives among them that degree of heat which converts it into flame, and the heat of that flame is communicated to the air of the room, as above explained.

4. The flame from the freſh coals laid on in this ſtove, deſcending through the coals already ignited, preſerves them long from conſuming, and continues them in the ſtate of red coals as long as the flame continues that ſurrounds them; by which means the fires made in this ſtove are of much longer duration than

in

in any other, and fewer coals are therefore neceſſary for a day. This is a very material advantage indeed. That flame ſhould be a kind of pickle, to preſerve burning coals from conſuming, may ſeem a paradox to many, and very unlikely to be true, as it appeared to me the firſt time I obſerved the fact. I muſt therefore relate the circumſtances, and ſhall mention an eaſy experiment, by which my reader may be in poſſeſſion of every thing neceſſary to the underſtanding of it. In the firſt trial I made of this kind of ſtove, which was conſtructed of thin plate iron, I had inſtead of the vaſe a kind of inverted pyramid like a mill-hopper; and fearing at firſt that the ſmall grate contained in it might be clogged by cinders, and the paſſage of the flame ſometimes obſtructed, I ordered a little door near the grate, by means of which I might on occaſion clear it: though after the ſtove was made, and before I tried it, I began to think this precaution ſuperfluous, from an imagination, that the flame being contracted in the narrow part where the grate was placed, would be more powerful in conſuming what it ſhould there meet with, and that any cinders between or near the bars would be preſently deſtroyed and the paſſage opened. After the ſtove was fixed and in action, I had a pleaſure now and then in opening that door a little, to ſee through the crevice how the flame deſcended among the red coals, and obſerving once a ſingle coal lodged on the bars in the

middle of the focus, a fancy took me to obſerve by my watch in how ſhort a time it would be conſumed. I looked at it long without perceiving it to be at all diminiſhed, which ſurpriſed me greatly. At length it occurred to me, that I and many others had ſeen the ſame thing thouſands of times, in the conſervation of the red coal formed in the ſnuff of a burning candle, which while envelloped in flame, and thereby prevented from the contact of paſſing air, is long continued, and augments inſtead of diminiſhing, ſo that we are often obliged to remove it by the ſnuffers, or bend it out of the flame into the air, where it conſumes preſently to aſhes. I then ſuppoſed that to conſume a body by fire, paſſing air was neceſſary to receive and carry off the ſeparated particles of the body; and that the air paſſing in the flame of my ſtove, and in the flame of a candle, being already ſaturated with ſuch particles, could not receive more, and therefore left the coal undiminiſhed as long as the outward air was prevented from coming to it by the ſurrounding flame, which kept it in a ſituation ſomewhat like that of charcoal in a well luted crucible, which, though long kept in a ſtrong fire, comes out unconſumed.

An eaſy experiment will ſatisfy any one of this conſerving power of flame envelloping red coal. Take a ſmall ſtick of deal, or other wood, the ſize of a gooſe quill, and hold it horizontally and ſteadily in the flame of the candle above

above the wick, without touching it, but in the body of the flame. The wood will firſt be inflamed, and burn beyond the edge of the flame of the candle, perhaps a quarter of an inch. When the flame of the wood goes out, it will leave a red coal at the end of the ſtick, part of which will be in the flame of the candle and part out in the air. In a minute or two you will perceive the coal in the air diminiſh gradually, ſo as to form a neck; while the part in the flame continues of its firſt ſize, and at length the neck being quite conſumed it drops off; and by rolling it between your fingers when extinguiſhed, you will find it ſtill a ſolid coal.

However, as one cannot be always putting on freſh fuel in this ſtove to furniſh a continual flame as is done in a candle, the air in the intervals of time gets at the red coals and conſumes them. Yet the conſervation, while it laſted, ſo much delayed the conſumption of the coals, that two fires, one made in the morning, and the other in the afternoon, each made by only a hatfull of coals, were ſufficient to keep my writing-room, about ſixteen feet ſquare and ten high, warm a whole day. The fire kindled at ſeven in the morning would burn till noon; and all the iron of the machine, with the walls of the niche, being thereby heated, the room kept warm till evening, when another ſmaller fire kindled kept it warm till midnight.

Inſtead of the ſliding plate E, which ſhuts

the front of the box C, I ſometimes uſed another which had a pane of glaſs, or, which is better, of Muſcovy talc, that the flame might be ſeen deſcending from the bottom of the vaſe, and paſſing in a column through the box C, into the cavities of the bottom plate, like water falling from a funnel, admirable to ſuch as are not acquainted with the nature of the machine, and in itſelf a pleaſing ſpectacle.

Every utenſil, however properly contrived to ſerve its purpoſe, requires ſome practice before it can be uſed adroitly. Put into the hands of a man, for the firſt time, a gimblet or a hammer (very ſimple inſtruments) and tell him the uſe of them, he ſhall neither bore a hole nor drive a nail with the dexterity or ſucceſs of another who has been a little accuſtomed to handle them. The beginner therefore in the uſe of this machine, will do well not to be diſcouraged with little accidents that may ariſe at firſt from his want of experience. Being ſomewhat complex, it requires, as already ſaid, a variety of attentions; habit will render them unneceſſary: and the ſtudious man who is much in his chamber, and has a pleaſure in managing his own fire, will ſoon find this a machine moſt comfortable and delightful. To others who leave their fires to the care of ignorant ſervants, I do not recommend it. They will with difficulty acquire the knowledge neceſſary, and will make frequent blunders that will fill your room with ſmoke. It is therefore by no means

fit

fit for common uſe in families. It may be adviſeable to begin with the flaming kind of ſtone coal, which is large, and, not caking together, is not ſo apt to clog the grate. After ſome experience, any kind of coal may be uſed, and with this advantage, that no ſmell, even from the moſt ſulphureous kind, can come into your room, the current of air being conſtantly into the vaſe, where too that ſmell is all conſumed.

The vaſe form was choſen as being elegant in itſelf, and very proper for burning of coals: where wood is the uſual fuel, and muſt be burnt in pieces of ſome length, a long ſquare cheſt may be ſubſtituted, in which A is the cover opening by a hing behind, B the grate, C the hearth-box with its diviſions as in the other, D the plan of the cheſt, E the long narrow grate. This I have not tried, but the vaſe machine was compleated in 1771, and uſed by me in London three winters, and one afterwards in America, much to my ſatisfaction; and I have not yet thought of any improvement it may be capable of, though ſuch may occur to others. For common uſe, while in France, I have contrived another grate for coals, which has in part the ſame property of burning the ſmoke and preſerving the red coals longer by the flame, though not ſo completely, as in the vaſe, yet ſufficiently to be very uſeful, which I ſhall now deſcribe as follows:

Plate 2. Figure 17.

A, is a round grate, one foot (French) in diameter,

meter, and eight inches deep between the bars and the back; the ſides and back of plate iron; the ſides having holes of half an inch diameter, diſtant 3 or 4 inches from each other, to let in air for enlivening the fire. The back without holes. The ſides do not meet at top nor at bottom by eight inches: that ſquare is filled by grates of ſmall bars croſſing front to back to let in air below, and let out the ſmoke or flame above. The three middle bars of the front grate are fixed; the upper and lower may be taken out and put in at pleaſure, when hot, with a pair of pincers. This round grate turns upon an axis, ſupported by the crotchet B, the ſtem of which is an inverted conical tube five inches deep, which comes on as many inches upon a pin that fits it, and which is fixed upright in a caſt iron plate D, that lies upon the hearth; in the middle of the top and bottom grates are fixed ſmall upright pieces E E, about an inch high, which, as the whole is turned on its axis, ſtop it when the grate is perpendicular. Figure 19 is another view of the ſame machine.

Plate 2. Figure 18.

In making the firſt fire in a morning with this grate, there is nothing particular to be obſerved. It is made as in other grates, the coals being put in above, after taking out the upper bar, and replacing it when they are in. The round figure of the fire when thoroughly kindled is agreeable, it repreſents the great giver of warmth to our ſyſtem. As it burns down

down and leaves a vacancy above, which you would fill with freſh coals, the upper bar is to be taken out, and afterwards replaced. The freſh coals, while the grate continues in the ſame poſition, will throw up, as uſual, a body of thick ſmoke. But every one accuſtomed to coal fires in common grates, muſt have obſerved, that pieces of freſh coal ſtuck in below among the red coals, have their ſmoke ſo heated as that it becomes flame as faſt as it is produced, which flame riſes among the coals and enlivens the appearance of the fire. Here then is the uſe of this ſwivel grate. By a puſh with your tongs or poker, you turn it on its pin till it faces the back of the chimney, then turn it over on its axis gently till it again faces the room, whereby all the freſh coals will be found under the live coals, and the greater part of the ſmoke ariſing from the freſh coals will in its paſſage through the live ones be heated ſo as to be converted into flame: whence you have much more heat from them, and your red coals are longer preſerved from conſuming. I conceive this conſtruction, though not ſo complete a conſumer of all the ſmoke as the vaſe, yet to be fitter for common uſe, and very advantageous. It gives too a full ſight of the fire, always a pleaſing object, which we have not in the other. It may with a touch be turned more or leſs from any one of the company that deſires to have leſs of its heat, or preſented full to one juſt come out of the cold. And ſupported

ported in a horizontal poſition, a tea-kettle may be boiled on it.

The author's deſcription of his Pennſylvania fire-place, firſt publiſhed in 1744, having fallen into the hands of workmen in Europe, who did not, it ſeems, well comprehend the principles of that machine, it was much diſfigured in their imitations of it; and one of its main intentions, that of admitting a ſufficient quantity of freſh air warmed in entering through the air-box, nearly defeated, by a pretended improvement, in leſſening its paſſages to make more room for coals in a grate. On pretence of ſuch improvements, they obtained patents for the invention, and for a while made great profit by the ſale, till the public became ſenſible of that defect, in the expected operation. If the ſame thing ſhould be attempted with this vaſe ſtove, it will be well for the buyer to examine thoroughly ſuch pretended improvements, leſt, being the mere productions of ignorance, they diminiſh or defeat the advantages of the machine, and produce inconvenience and diſappointment.

The method of burning ſmoke, by obliging it to deſcend through hot coals, may be of great uſe in heating the walls of a hot-houſe. In the common way, the horizontal paſſages or flues that are made to go and return in thoſe walls, loſe a great deal of their effect when they come to be foul with ſoot; for a thick blanket-like lining of ſoot prevents much of the

the hot air from touching and heating the brick-work in its paſſage, ſo that more fire muſt be made as the flue grows fouler: but by burning the ſmoke they are kept always clean. The ſame method may alſo be of great advantage to thoſe buſineſſes in which large coppers or caldrons are to be heated.

Written at Sea, 1785.

METEOROLOGICAL CONJECTURES, &c.

THERE ſeems to be a region higher in the air over all countries, where it is always winter, where froſt exiſts continually, ſince, in the midſt of ſummer on the ſurface of the earth, ice falls often from above in the form of hail.

Hailſtones, of the great weight we ſometimes find them, did not probably acquire their magnitude before they began to deſcend. The air, being eight hundred times rarer than water, is unable to ſupport it but in the ſhape of vapour, a ſtate in which its particles are ſeparated. As ſoon as they are condenſed by the cold of the upper region, ſo as to form a drop, that drop begins to fall. If it freezes into a grain of ice, that ice deſcends. In deſcending, both the drop of water, and the grain of ice, are augmented by particles of the vapour they paſs through in falling, and which they condenſe by their coldneſs, and attach to themſelves.

It is poſſible that, in ſummer, much of what is rain, when it arrives at the ſurface of the earth, might have been ſnow, when it began its deſcent; but being thawed, in paſſing through the warm air near the ſurface, it is changed from ſnow into rain.

How

How immenſely cold muſt be the original particle of hail, which forms the center of the future hailſtone, ſince it is capable of communicating ſufficient cold, if I may ſo ſpeak, to freeze all the maſs of vapour condenſed round it, and form a lump of perhaps ſix or eight ounces in weight!

When, in ſummer time, the ſun is high, and continues long every day above the horizon, his rays ſtrike the earth more directly, and with longer continuance, than in the winter; hence, the ſurface is more heated, and to a greater depth, by the effect of thoſe rays.

When rain falls on the heated earth, and ſoaks down into it, it carries down with it a great part of the heat, which by that means deſcends ſtill deeper.

The maſs of earth, to the depth perhaps of thirty feet, being thus heated to a certain degree, continues to retain its heat for ſome time. Thus the firſt ſnows that fall in the beginning of winter, ſeldom lie long on the ſurface, but are ſoon melted, and ſoon abſorbed. After which, the winds that blow over the country on which the ſnows had fallen, are not rendered ſo cold as they would have been by thoſe ſnows, if they had remained. And thus the approach of the ſeverity of winter is retarded; and the extreme degree of its cold is not always at the time we might expect it, viz. when the ſun is at its greateſt diſtance, and the day ſhorteſt, but ſome time after that period,

according to the Engliſh proverb, which ſays, "as the day lengthens, the cold ſtrengthens;" the cauſes of refrigeration continuing to operate, while the ſun returns too ſlowly, and his force continues too weak to counteract them.

During ſeveral of the ſummer months of the year 1783, when the effect of the ſun's rays to heat the earth in theſe northern regions ſhould have been greateſt, there exiſted a conſtant fog over all Europe, and great part of North America. This fog was of a permanent nature; it was dry, and the rays of the ſun ſeemed to have little effect towards diſſipating it, as they eaſily do a moiſt fog, ariſing from water. They were indeed rendered ſo faint in paſſing through it, that when collected in the focus of a burning-glaſs, they would ſcarce kindle brown paper. Of courſe, their ſummer effect in heating the earth was exceedingly diminiſhed.

Hence the ſurface was early frozen.

Hence the firſt ſnows remained on it unmelted, and received continual additions.

Hence the air was more chilled, and the winds more ſeverely cold.

Hence perhaps the winter of 1783-4 was more ſevere than any that had happened for many years.

The cauſe of this univerſal fog is not yet aſcertained. Whether it was adventitious to this earth, and merely a ſmoke, proceeding from the conſumption by fire of ſome of thoſe great burning

burning balls or globes which we happen to meet with in our rapid courſe round the ſun, and which are ſometimes ſeen to kindle and be deſtroyed in paſſing our atmoſphere, and whoſe ſmoke might be attracted and retained by our earth: or whether it was the vaſt quantity of ſmoke, long continuing to iſſue during the ſummer from *Hecla* in Iceland, and that other volcano which aroſe out of the ſea near that iſland, which ſmoke might be ſpread by various winds over the northern part of the world, is yet uncertain.

It ſeems however worth the enquiry, whether other hard winters, recorded in hiſtory, were preceded by ſimilar permanent and widely extended ſummer fogs. Becauſe, if found to be ſo, men might from ſuch fogs conjecture the probability of a ſucceeding hard winter, and of the damage to be expected by the breaking up of frozen rivers in the ſpring; and take ſuch meaſures as are poſſible and practicable, to ſecure themſelves and effects from the miſchiefs that attended the laſt.

Paſſy, May 1784.

Letter to Mr. NAIRNE, *of London.*

SIR, Paſſy, near Paris, Nov, 13th, 1780.

THE qualities hitherto ſought in a hygrometer, or inſtrument to diſcover the degrees of moiſture and dryneſs in the air, ſeem to have been, an aptitude to receive humidity readily from a moiſt air, and to part with it as readily to a dry air. Different ſubſtances have been found to poſſeſs more or leſs of this quality; but when we ſhall have found the ſubſtance that has it in the greateſt perfection, there will ſtill remain ſome uncertainty in the concluſions to be drawn from the degree ſhown by the inſtrument, ariſing from the actual ſtate of the inſtrument itſelf as to heat and cold. Thus, if two bottles or veſſels of glaſs or metal being filled, the one with cold and the other with hot water, are brought into a room, the moiſture of the air in the room will attach itſelf in quantities to the ſurface of the cold veſſel, while if you actually wet the ſurface of the hot veſſel, the moiſture will immediately quit it, and be abſorbed by the ſame air. And thus in a ſudden change of the air from cold to warm, the inſtrument remaining longer cold may condenſe and abſorb more moiſture, and mark the air as having become more humid than it is in reality, and the contrary in a change from warm to cold.

But

But if ſuch a ſuddenly changing inſtrument could be freed from theſe imperfections, yet when the deſign is to diſcover the different degrees of humidity in the air of different countries, I apprehend the quick ſenſibility of the inſtrument to be rather a diſadvantage; ſince, to draw the deſired concluſions from it, a conſtant and frequent obſervation day and night in each country will be neceſſary for a year or years, and the mean of each different ſet of obſervations is to be found and determined. After all which ſome uncertainty will remain reſpecting the different degrees of exactitude with which different perſons may have made and taken notes of their obſervations.

For theſe reaſons, I apprehend that a ſubſtance which, though capable of being diſtended by moiſture and contracted by dryneſs, is ſo ſlow in receiving and parting with its humidity, that the frequent changes in the atmoſphere have not time to affect it ſenſibly, and which therefore ſhould gradually take nearly the medium of all thoſe changes, and preſerve it conſtantly, would be the moſt proper ſubſtance of which to make ſuch an hygrometer.

Such an inſtrument, you, my dear ſir, though without intending it, have made for me; and I, without deſiring or expecting it, have received from you. It is therefore with propriety that I addreſs to you the following account of it; and the more, as you have both a head to contrive and a hand to execute the means of

perfecting it. And I do this with greater pleaſure, as it affords me the opportunity of renewing that antient correſpondence and acquaintance with you, which to me was always ſo pleaſing and ſo inſtructive.

You may poſſibly remember, that in or about the year 1758, you made for me a ſet of artificial magnets, ſix in number, each five and a half inches long, half an inch broad, and one eighth of an inch thick. Theſe, with two pieces of ſoft iron, which together equalled one of the magnets, were incloſed in a little box of mahogany wood, the grain of which ran with, and not acroſs, the length of the box; and the box was cloſed by a little ſhutter of the ſame wood, the grain of which ran acroſs the box; and the ends of this ſhutting piece were bevelled ſo as to fit and ſlide in a kind of dovetail groove when the box was to be ſhut or opened.

I had been of opinion that good mahogany wood was not affected by moiſture ſo as to change its dimenſions, and that it was always to be found as the tools of the workman left it. Indeed the difference at different times in the ſame country, is ſo ſmall as to be ſcarcely in a common way obſervable. Hence the box which was made ſo as to allow ſufficient room for the magnets to ſlide out and in freely, and, when in, afforded them ſo much play, that by ſhaking the box one could make them ſtrike the oppoſite ſides alternately, continued in the

ſame

ſame ſtate all the time I remained in England, which was four years, without any apparent alteration. I left England in Auguſt 1762, and arrived at Philadelphia in October the ſame year. In a few weeks after my arrival, being deſirous of ſhewing your magnets to a philoſophical friend, I found them ſo tight in the box, that it was with difficulty I got them out; and conſtantly during the two years I remained there, viz. till November 1764, this difficulty of getting them out and in continued. The little ſhutter too, as wood does not ſhrink lengthways of the grain, was found too long to enter its grooves, and not being uſed, was miſlaid and loſt; and I afterwards had another made that fitted.

In December 1764 I returned to England, and after ſome time I obſerved that my box was become full big enough for my magnets, and too wide for my new ſhutter; which was ſo much too ſhort for its grooves, that it was apt to fall out; and to make it keep in, I lengthened it by adding to each end a little coat of ſealing-wax.

I continued in England more than ten years, and during all that time, after the firſt change, I perceived no alteration. The magnets had the ſame freedom in their box, and the little ſhutter continued with the added ſealing-wax to fit its grooves, till ſome weeks after my ſecond return to America.

As I could not imagine any other cauſe for this

this change of dimenſions in the box, when in the different countries, I concluded, firſt, generally, that the air of England was moiſter than that of America. And this I ſuppoſed an effect of its being an iſland, where every wind that blew muſt neceſſarily paſs over ſome ſea before it arrived, and of courſe lick up ſome vapour. I afterwards indeed doubted whether it might be juſt only ſo far as related to the city of London, where I reſided; becauſe there are many cauſes of moiſture in the city air, which do not exiſt to the ſame degree in the country; ſuch as the brewers and dyers boiling caldrons, and the great numbers of pots and tea-kettles continually on the fire, ſending forth abundance of vapour; and alſo the number of animals, who by their breath continually increaſe it; to which may be added, that even the vaſt quantity of ſea coals burnt there do, in kindling, diſcharge a great deal of moiſture.

When I was in England, the laſt time, you alſo made for me a little achromatic pocket teleſcope; the body was braſs, and it had a round caſe (I think of thin wood) covered with ſhagrin. All the while I remained in England, though poſſibly there might be ſome ſmall changes in the dimenſions of this caſe, I neither perceived nor ſuſpected any. There was always comfortable room for the teleſcope to ſlip in and out. But ſoon after I arrived in America, which was in May 1775, the caſe became too ſmall for the inſtrument; it was with much

much difficulty and various contrivances that I got it out, and I could never after get it in again, during my ſtay there, which was eighteen months. I brought it with me to Europe, but left the caſe as uſeleſs, imagining that I ſhould find the continental air of France as dry as that of Pennſylvania, where my magnet box had alſo returned a ſecond time to its narrowneſs, and pinched the pieces, as heretofore, obliging me too to ſcrape the ſealing-wax off the ends of the ſhutter.

I had not been long in France, before I was ſurpriſed to find, that my box was become as large as it had always been in England, the magnets entered and came out with the ſame freedom, and, when in, I could rattle them againſt its ſides; this has continued to be the caſe without ſenſible variation. My habitation is out of Paris diſtant almoſt a league, ſo that the moiſt air of the city cannot be ſuppoſed to have much effect upon the box. I am on a high dry hill in a free air, as likely to be dry as any air in France. Whence it ſeems probable that the air of England in general may, as well as that of London, be moiſter than the air of America, ſince that of France is ſo, and in a part ſo diſtant from the ſea.

The greater dryneſs of the air in America appears from ſome other obſervations. The cabinet work formerly ſent us from London, which conſiſted in thin plates of fine wood glued upon fir, never would ſtand with us, the

vaneering, as thoſe plates are called, would get looſe and come off; both woods ſhrinking, and their grains often croſſing, they were forever cracking and flying. And in my electrical experiments there, it was remarkable, that a mahogany table, on which my jars ſtood under the prime conductor to be charged, would often be ſo dry, particularly when the wind had been ſome time at north-weſt, which with us is a very drying wind, as to iſolate the jars, and prevent their being charged till I had formed a communication between their coatings and the earth. I had a like table in London, which I uſed for the ſame purpoſe all the time I reſided there; but it was never ſo dry as to refuſe conducting the electricity.

Now what I would beg leave to recommend to you, is, that you would recollect, if you can, the ſpecies of mahogany of which you made my box, for you know there is a good deal of difference in woods that go under that name; or, if that cannot be, that you would take a number of pieces of the cloſeſt and fineſt grained mahogany that you can meet with, plane them to the thinneſs of about a line, and the width of about two inches acroſs the grain, and fix each of the pieces in ſome inſtrument that you can contrive, which will permit them to contract and dilate, and will ſhow, in ſenſible degrees, by a moveable hand upon a marked ſcale, the otherwiſe leſs ſenſible quantities of ſuch contraction and dilatation. If

theſe inſtruments are all kept in the ſame place while making, and are graduated together while ſubject to the ſame degrees of moiſture or dryneſs, I apprehend you will have ſo many comparable hygrometers, which being ſent into different countries, and continued there for ſome time, will find and ſhow there the mean of the different dryneſs and moiſture of the air of thoſe countries, and that with much leſs trouble than by any hygrometer hitherto in uſe.

With great eſteem,

I am, dear ſir,

Your moſt obedient,

And moſt humble ſervant,

B. FRANKLIN.

A Letter

A Letter from Dr. BENJAMIN FRANKLIN, *to* Mr. ALPHONSUS le ROY, *Member of ſeveral Academies, at Paris. Containing ſundry Maritime Obſervations.*

At Sea, on board the London Packet,
Capt. Truxton, Auguſt 1785.

SIR,

YOUR learned writings on the navigation of the antients, which contain a great deal of curious information; and your very ingenious contrivances for improving the modern ſails *(voilure)* of which I ſaw with great pleaſure a ſucceſsful trial on the river Seine, have induced me to ſubmit to your conſideration and judgment, ſome thoughts I have had on the latter ſubject.

Thoſe mathematicians who have endeavoured to improve the ſwiftneſs of veſſels, by calculating to find the form of leaſt reſiſtance, ſeem to have conſidered a ſhip as a body moving through one fluid only, the water; and to have given little attention to the circumſtance of her moving through another fluid, the air. It is true that when a veſſel ſails right before the wind, this circumſtance is of no importance, becauſe the wind goes with her; but in every deviation from that courſe, the reſiſtance of the air is ſomething, and becomes greater in proportion as that deviation increaſes. I wave at preſent the conſideration of thoſe different degrees

Fig. 1.

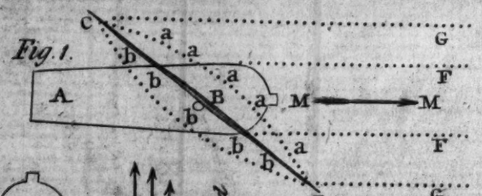


Fig. 2.

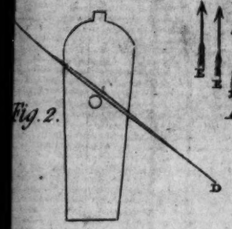


Fig. 3.

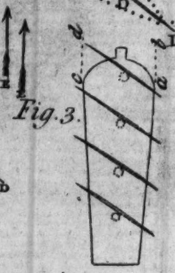


Fig. 4.

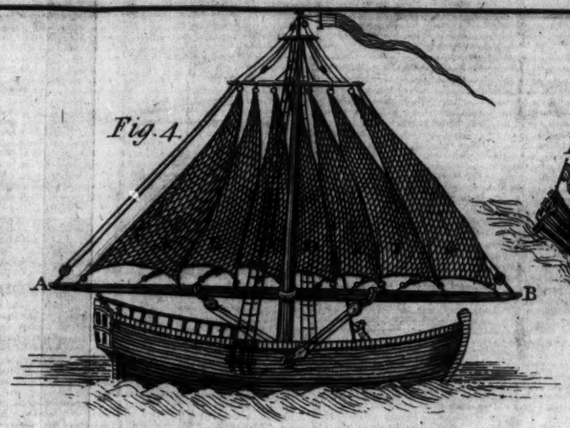


Fig. 5.

Fig. 6.

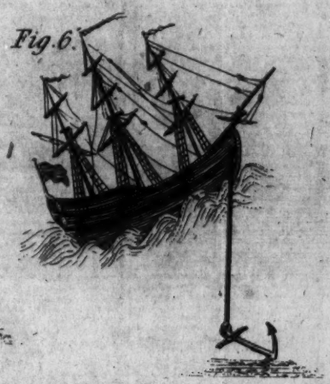


Fig. 7.

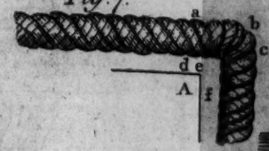


Fig. 8.

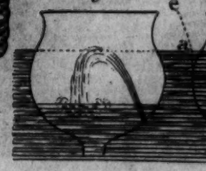


Fig. 9.

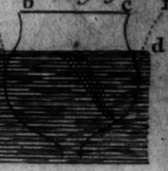


Fig. 10.

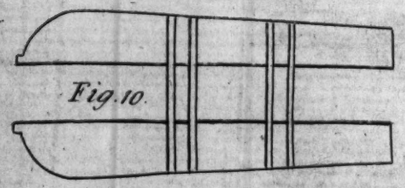


Fig. 11.

Fig. 12.

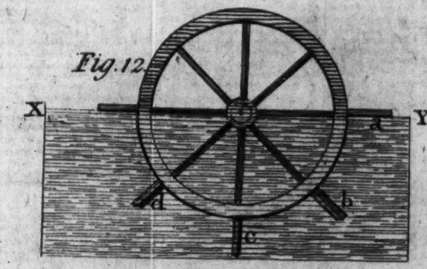


Fig. 13.

Fig. 14.

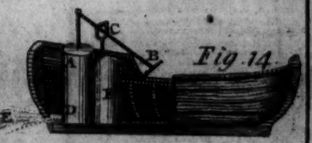
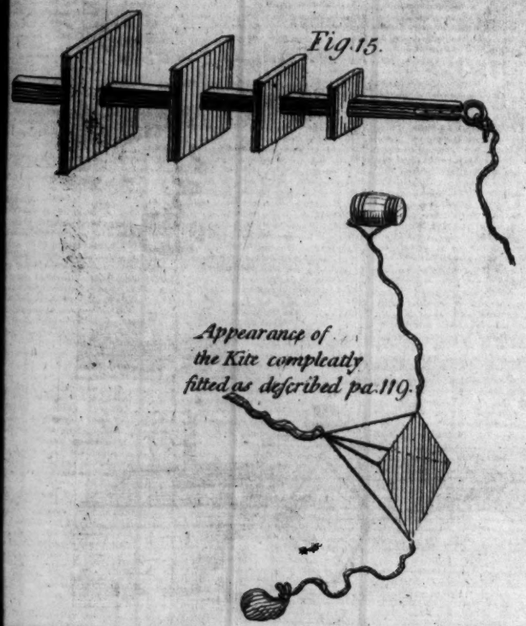


Fig. 15.



Appearance of the Kite compleatly fitted as described pa. 119.

Fig. 16.

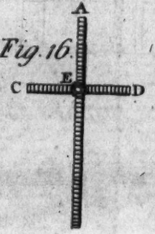


Fig. 17.

Fig. 18.

Fig. 19.

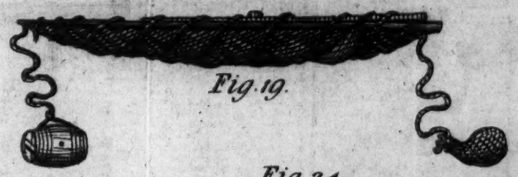


Fig. 20.

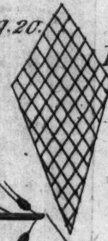


Fig. 21.

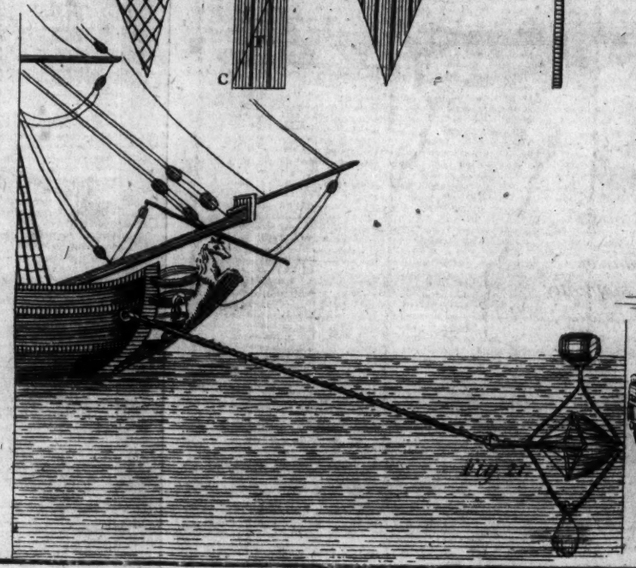


Fig. 22.

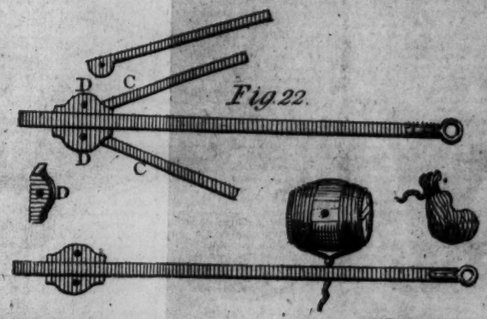
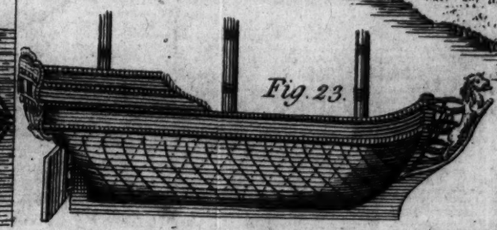


Fig. 23.



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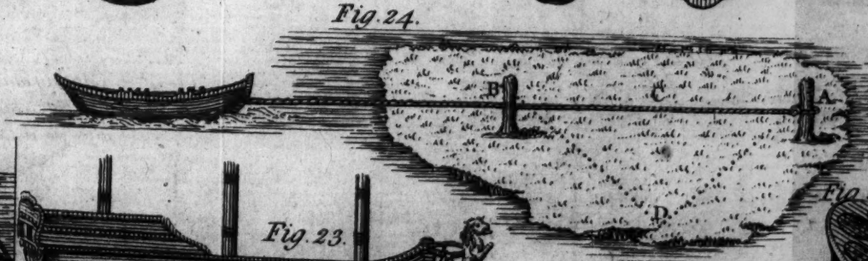

Fig. 25.

Fig. 26.

Fig. 27.

grees of reſiſtance given by the air to that part of the hull which is above water, and confine myſelf to that given to the ſails; for their motion through the air is reſiſted by the air, as the motion of the hull through the water is reſiſted by the water, though with leſs force, as the air is a lighter fluid. And to ſimplify the diſcuſſion as much as poſſible, I would ſtate one ſituation only, to wit, that of the wind upon the beam, the ſhip's courſe being directly acroſs the wind; and I would ſuppoſe the ſail ſet in an angle of 45 degrees with the keel, as in the following figure; wherein

A B repreſents the body of the veſſel, C D the poſition of the ſail, E E E the direction of the wind, M M the line of motion. In obſerving this figure it will appear, that ſo much of the body of the veſſel as is immerſed in the water muſt, to go forward, remove out of its way what water it meets with between the pricked lines F F. And the ſail, to go forward, muſt move out of its way all the air its whole dimenſion meets with between the pricked lines C G and D G. Thus both the fluids give reſiſtance to the motion, each in proportion to the quantity of matter contained in the dimenſion to be removed. And though the air is vaſtly lighter than the water, and therefore more eaſily removed, yet the dimenſion being much greater, its effect is very conſiderable.

Plate IV. Figure 1.

It is true that in the caſe ſtated, the reſiſtance given by the air between thoſe lines to the

the motion of the ſail is not apparent to the eye, becauſe the greater force of the wind which ſtrikes it in the direction E E E, overpowers its effect, and keeps the ſail full in the curve a, a, a, a, a. But ſuppoſe the wind to ceaſe, and the veſſel in a calm to be impelled with the ſame ſwiftneſs by oars, the ſail would then appear filled in the contrary curve b, b, b, b, b, when prudent men would immediately perceive that the air reſiſted its motion, and would order it to be taken in.

Is there any poſſible means of diminiſhing this reſiſtance, while the ſame quantity of ſail is expoſed to the action of the wind, and therefore the ſame force obtained from it ? I think there is, and that it may be done by dividing the ſail into a number of parts, and placing thoſe parts in a line one behind the other ; thus, inſtead of one ſail extending from C to D, figure 2, if four ſails, containing together the ſame quantity of canvas, were placed as in figure 3, each having one quarter of the dimenſions of the great ſail, and expoſing a quarter of its ſurface to the wind, would give a quarter of the force ; ſo that the whole force obtained from the wind would be the ſame, while the reſiſtance from the air would be nearly reduced to the ſpace between the pricked lines *a b* and *c d*, before the foremoſt ſail.

It may perhaps be doubted whether the reſiſtance from the air would be ſo diminiſhed ; ſince poſſibly each of the following ſmall ſails having alſo air before it, which muſt be removed,

moved, the reſiſtance on the whole would be the ſame.

This is then a matter to be determined by experiment. I will mention one that I many years ſince made with ſucceſs for another purpoſe; and I will propoſe another ſmall one eaſily made. If that too ſucceeds, I ſhould think it worth while to make a larger, though at ſome expence, on a river boat; and perhaps time, and the improvements experience will afford, may make it applicable with advantage to larger veſſels.

Having near my kitchen chimney a round hole of eight inches diameter, through which was a conſtant ſteady current of air, increaſing or diminiſhing only as the fire increaſed or diminiſhed, I contrived to place my jack ſo as to receive that current; and taking off the flyers, I fixed in their ſtead on the ſame pivot a round tin plate of near the ſame diameter with the hole; and having cut it in radial lines almoſt to the centre, ſo as to have ſix equal vanes, I gave to each of them the obliquity of forty-five degrees. They moved round, without the weight, by the impreſſion only of the current of air, but too ſlowly for the purpoſe of roaſting. I ſuſpected that the air ſtruck by the back of each vane might poſſibly by its reſiſtance retard the motion; and to try this, I cut each of them into two, and I placed the twelve, each having the ſame obliquity, in a line behind each other, when I perceived a great augmen-

tation in its velocity, which encouraged me to divide them once more, and, continuing the ſame obliquity, I placed the twenty-four behind each other in a line, when the force of the wind being the ſame, and the ſurface of vane the ſame, they moved round with much greater rapidity, and perfectly anſwered my purpoſe.

The ſecond experiment that I propoſe, is, to take two playing cards of the ſame dimenſions, and cut one of them tranſverſely into eight equal pieces; then with a needle ſtring them upon two threads, one near each end, and place them ſo upon the threads that, when hung up, they may be one exactly over the other, at a diſtance equal to their breadth, each in a horizontal poſition; and let a ſmall weight, ſuch as a bird-ſhot, be hung under them, to make them fall in a ſtraight line when let looſe. Suſpend alſo the whole card by threads from its four corners, and hang to it an equal weight, ſo as to draw it downwards when let fall, its whole breadth preſſing againſt the air. Let thoſe two bodies be attached, one of them to one end of a thread a yard long, the other to the other end. Extend a twine under the ceiling of a room, and put through it, at thirty inches diſtance, two pins bent in the form of fiſh-hooks. On theſe two hooks hang the two bodies, the thread that connects them extending parallel to the twine, which thread being cut, they muſt begin to fall at the ſame inſtant. If they take equal time in falling to the floor, it is a proof that

that the reſiſtance of the air is in both caſes equal. If the whole card requires a longer time, it ſhows that the ſum of the reſiſtances to the pieces of the cut card is not equal to the reſiſtance of the whole one *.

This principle ſo far confirmed, I would proceed to make a larger experiment, with a ſhallop, which I would rig in this manner.

A B is a long boom, from which are hoiſted ſeven jibs, a, b, c, d, e, f, g, each a ſeventh part of the whole dimenſions, and as much more as will fill the whole ſpace when ſet in an angle of forty-five degrees, ſo that they may lap when going before the wind, and hold more wind when going large. Thus rigged, when going right before the wind, the boom ſhould be brought at right angles with the keel, by means of the ſheet ropes C D, and all the ſails hauled flat to the boom. Plate IV. Figure 4.

Theſe poſitions of boom and ſails to be varied as the wind quarters. But when the wind is on the beam, or when you would turn to windward, the boom is to be hauled right fore and aft, and the ſails trimmed according as the wind is more or leſs againſt your courſe.

It ſeems to me that the management of a ſhallop ſo rigged would be very eaſy, the ſails being run up and down ſeparately, ſo that more or leſs ſail may be made at pleaſure, and I ima-

* The motion of the veſſel made it inconvenient to try this ſimple experiment, at ſea, when the propoſal of it was written. But it has been tried ſince we came on ſhore, and ſucceeded as the other.

gine, that there being full as much ſail expoſed to the force of the wind which impels the veſſel in its courſe, as if the whole were in one piece, and the reſiſtance of the dead air againſt the foreſide of the ſail being diminiſhed, the advantage of ſwiftneſs would be very conſiderable; beſides that the veſſel would lie nearer the wind.

Since we are on the ſubject of improvements in navigation, permit me to detain you a little longer with a ſmall relative obſervation. Being, in one of my voyages, with ten merchantſhips under convoy of a frigate at anchor in Torbay, waiting for a wind to go to the weſtward; it came fair, but brought in with it a conſiderable ſwell. A ſignal was given for weighing, and we put to ſea all together; but three of the ſhips left their anchors, their cables parting juſt as the anchors came a-peak. Our cable held, and we got up our anchor; but the ſhocks the ſhip felt before the anchor got looſe from the ground, made me reflect on what might poſſibly have cauſed the breaking of the other cables; and I imagined it might be the ſhort bending of the cable, juſt without the hauſe-hole, from a horizontal to an almoſt vertical poſition, and the ſudden violent jerk it receives by the riſing of the head of the ſhip on the ſwell of a wave while in that poſition. For example, ſuppoſe a veſſel hove up ſo as to have her head nearly over her anchor, which ſtill keeps its hold, perhaps in a tough bottom;

tom; if it were calm, the cable ſtill out would form nearly a perpendicular line, meaſuring the diſtance between the hauſe-hole and the anchor; but if there is a ſwell, her head in the trough of the ſea will fall below the level, and when lifted on the wave will be as much above it. In the firſt caſe the cable will hang looſe, and bend perhaps as in figure 5. In the ſecond caſe, figure 6, the cable will be drawn ſtraight with a jerk, muſt ſuſtain the whole force of the riſing ſhip, and muſt either looſen the anchor, reſiſt the riſing force of the ſhip, or break. But why does it break at the hauſe-hole?

Let us ſuppoſe it a cable of three inches diameter, and repreſented by figure 7. If this cable is to be bent round the corner A, it is evident that either the part of the triangle contained between the letters a, b, c, muſt ſtretch conſiderably, and thoſe moſt that are neareſt the ſurface; or that the parts between d, e, f, muſt be compreſſed; or both, which moſt probably happens. In this caſe the lower half of the thickneſs affords no ſtrength againſt the jerk, it not being ſtrained; the upper half bears the whole; and the yarns near the upper ſurface being firſt and moſt ſtrained, break firſt, and the next yarns follow; for in this bent ſituation they cannot bear the ſtrain all together, and each contribute its ſtrength to the whole, as they do when the cable is ſtrained in a ſtraight line.

To remedy this, methinks it would be well to have a kind of large pulley wheel, fixed in the hauſe-hole, ſuppoſe of two feet diameter, over which the cable might paſs; and being there bent gradually to the round of the wheel, would thereby be more equally ſtrained, and better able to bear the jerk, which may ſave the anchor, and by that means, in the courſe of the voyage, may happen to ſave the ſhip.

One maritime obſervation more ſhall finiſh this letter. I have been a reader of news-papers now near ſeventy years, and I think few years paſs without an account of ſome veſſel met with at ſea, with no ſoul living on board, and ſo many feet of water in her hold, which veſſel has nevertheleſs been ſaved and brought into port: and when not met with at ſea, ſuch forſaken veſſels have often come aſhore on ſome coaſt. The crews who have taken to their boats, and thus abandoned ſuch veſſels, are ſometimes met with and taken up at ſea by other ſhips, ſometimes reach a coaſt, and are ſometimes never heard of. Thoſe that give an account of quitting their veſſels, generally ſay, that ſhe ſprung a leak, that they pumped for ſome time, that the water continued to riſe upon them, and that, deſpairing to ſave her, they had quitted her, leſt they ſhould go down with her. It ſeems by the event that this fear was not always well founded, and I have endeavoured to gueſs at the reaſon of the people's too haſty diſcouragement.

When a veſſel ſprings a leak near her bottom, the water enters with all the force given by the weight of the column of water without, which force is in proportion to the difference of level between the water without and that within. It enters therefore with more force at firſt, and in greater quantity, than it can afterwards when the water within is higher. The bottom of the veſſel too is narrower, ſo that the ſame quantity of water coming into that narrow part, riſes faſter than when the ſpace for it to flow in is larger. This helps to terrify. But as the quantity entering is leſs and leſs as the ſurfaces without and within become more nearly equal in height, the pumps that could not keep the water from riſing at firſt, might afterwards be able to prevent its riſing higher, and the people might have remained on board in ſafety, without hazarding themſelves in an open boat on the wide ocean. (Fig. 8.)

Beſides the greater equality in the height of the two ſurfaces, there may ſometimes be other cauſes that retard the farther ſinking of a leaky veſſel. The riſing water within may arrive at quantities of light wooden work, empty cheſts, and particularly empty water-caſks, which, if fixed ſo as not to float themſelves, may help to ſuſtain her. Many bodies which compoſe a ſhip's cargo may be ſpecifically lighter than water; all theſe, when out of water, are an additional weight to that of the ſhip, and ſhe is

in proportion preſſed deeper into the water; but as ſoon as theſe bodies are immerſed, they weigh no longer on the ſhip, but on the contrary, if fixed, they help to ſupport her, in proportion as they are ſpecifically lighter than the water. And it ſhould be remembered, that the largeſt body of a ſhip may be ſo balanced in the water, that an ounce leſs or more of weight may leave her at the ſurface, or ſink her to the bottom. There are alſo certain heavy cargoes, that, when the water gets at them, are continually diſſolving, and thereby lightening the veſſel, ſuch as ſalt and ſugar. And as to water-caſks, mentioned above, ſince the quantity of them muſt be great in ſhips of war where the number of men conſume a great deal of water every day, if it had been made a conſtant rule to bung them up as faſt as they were emptied, and to diſpoſe the empty caſks in proper ſituations, I am perſuaded that many ſhips which have been ſunk in engagements, or have gone down afterwards, might, with the unhappy people, have been ſaved; as well as many of thoſe which in the laſt war foundered, and were never heard of. While on this topic of ſinking, one cannot help recollecting the well-known practice of the Chineſe, to divide the hold of a great ſhip into a number of ſeparate chambers, by partitions tight caulked (of which you gave a model in your boat upon the Seine) ſo that if a leak ſhould ſpring in one of them, the others are not affected by it; and though that chamber

chamber ſhould fill to a level with the ſea, it would not be ſufficient to ſink the veſſel. We have not imitated this practice. Some little diſadvantage it might occaſion in the ſtowage is perhaps one reaſon, though that I think might be more than compenſated by an abatement in the inſurance that would be reaſonable, and by a higher price taken of paſſengers, who would rather prefer going in ſuch a veſſel. But our ſeafaring people are brave, deſpiſe danger, and reject ſuch precautions of ſafety, being cowards only in one ſenſe, that of *fearing* to be *thought afraid*.

I promiſed to finiſh my letter with the laſt obſervation, but the garrulity of the old man has got hold of me, and as I may never have another occaſion of writing on this ſubject, I think I may as well now, once for all, empty my nautical budget, and give you all the thoughts that have, in my various long voyages, occurred to me relating to navigation. I am ſure that in you they will meet with a candid judge, who will excuſe my miſtakes on account of my good intention.

There are ſix accidents that may occaſion the loſs of ſhips at ſea. We have conſidered one of them, that of foundering by a leak. The other five are, 1. Overſetting by ſudden flaws of wind, or by carrying ſail beyond the bearing. 2. Fire, by accident or careleſſneſs. 3. A heavy ſtroke of lightning, making a breach in the ſhip, or firing the powder. 4. Meeting and ſhocking

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ing with other ſhips in the night. 5. Meeting in the night with iſlands of ice.

To that of overſetting, privateers in their firſt cruize have, as far as has fallen within my knowledge or information, been more ſubject than any other kind of veſſels. The double deſire of being able to overtake a weaker flying enemy, or to eſcape when purſued by a ſtronger, has induced the owners to overmaſt their cruizers, and to ſpread too much canvas; and the great number of men, many of them not ſeamen, who being upon deck when a ſhip heels, ſuddenly are huddled down to leeward, and increaſe by their weight the effect of the wind. This therefore ſhould be more attended to and guarded againſt, eſpecially as the advantage of lofty maſts is problematical: for the upper ſails have greater power to lay a veſſel more on her ſide, which is not the moſt advantageous poſition for going ſwiftly through the water. And hence it is that veſſels which have loſt their lofty maſts, and been able to make little more ſail afterwards than permitted the ſhip to ſail upon an even keel, have made ſo much way, even under jury maſts, as to ſurprize the mariners themſelves. But there is beſides, ſomething in the modern form of our ſhips that ſeems as if calculated expreſsly to allow their overſetting more eaſily. The ſides of a ſhip, inſtead of ſpreading out as they formerly did in the upper works, are of late years turned in, ſo as to make the body nearly round,

round, and more reſembling a caſk. I do not know what the advantages of this conſtruction are, except that ſuch ſhips are not ſo eaſily boarded. To me it ſeems a contrivance to have leſs room in a ſhip at nearly the ſame expence. For it is evident that the ſame timber and plank conſumed in raiſing the ſides from a to b, and from d to c, would have raiſed them from a to e, and from d to f, fig. 9. In this form all the ſpaces between e, a, b, and c, d, f, would have been gained; the deck would have been larger; the men would have had more room to act, and not have ſtood ſo thick in the way of the enemy's ſhot; and the veſſel, the more ſhe was laid down on her ſide, the more bearing ſhe would meet with, and more effectual to ſupport her, as being farther from the center. Whereas in the preſent form, her ballaſt makes the chief part of her bearing, without which ſhe would turn in the ſea almoſt as eaſily as a barrel. More ballaſt by this means becomes neceſſary, and that ſinking a veſſel deeper in the water, occaſions more reſiſtance to her going through it. The Bermudian ſloops ſtill keep with advantage to the old ſpreading form. The iſlanders in the great Pacific ocean, though they have no large ſhips, are the moſt expert boat-ſailors in the world, navigating that ſea ſafely with their proas, which they prevent overſetting by various means. Their ſailing proas for this purpoſe have outriggers generally to windward, above the water, on which one

one or more men are placed, to move occaſionally further from or nearer to the veſſel as the wind freſhens or ſlackens. But ſome have their outriggers to leeward, which reſting on the water, ſupport the boat ſo as to keep her upright when preſſed down by the wind. Their boats, moved by oars, or rather by paddles, are, for long voyages, fixed two together by croſs bars of wood, that keep them at ſome diſtance from each other, and ſo render their overſetting next to impoſſible. How far this may be practicable in larger veſſels, we have not yet ſufficient experience. I know of but one trial made in Europe, which was about one hundred years ſince, by Sir William Petty. He built a double veſſel, to ſerve as a pacquet-boat between England and Ireland. Her model ſtill exiſts in the muſeum of the Royal Society, where I have ſeen it. By the accounts we have of her, ſhe anſwered well the purpoſe of her conſtruction, making ſeveral voyages; and though wrecked at laſt by a ſtorm, the misfortune did not appear owing to her particular conſtruction, ſince many other veſſels of the common form were wrecked at the ſame time. The advantage of ſuch a veſſel is, that ſhe needs no ballaſt, therefore ſwims either lighter or will carry more goods; and that paſſengers are not ſo much incommoded by her rolling: to which may be added, that if ſhe is to defend herſelf by her cannon, they will probably have more effect, being kept more generally in a horizontal

zontal poſition, than thoſe in common veſſels. I think however that it would be an improvement of that model, to make the ſides which are oppoſed to each other perfectly parallel, though the other ſides are formed as in common thus, figure 10.

The building of a double ſhip would indeed be more expenſive in proportion to her burthen; and that perhaps is ſufficient to diſcourage the method.

The accident of fire is generally well guarded againſt by the prudent captain's ſtrict orders againſt ſmoking between decks, or carrying a candle there out of a lanthorn. But there is one dangerous practice which frequent terrible accidents have not yet been ſufficient to aboliſh; that of carrying ſtore-ſpirits to ſea in caſks. Two large ſhips, Seraphis and the Duke of Athol, one an Eaſt-Indiaman, the other a frigate, have been burnt within theſe two laſt years, and many lives miſerably deſtroyed, by drawing ſpirits out of a caſk near a candle. It is high time to make it a general rule, that all the ſhip's ſtore of ſpirits ſhould be carried in bottles.

The misfortune by a ſtroke of lightning I have in my former writings endeavoured to ſhow a method of guarding againſt, by a chain and pointed rod, extending, when run up, from above the top of the maſt to the ſea. Theſe inſtruments are now made and ſold at a reaſonable price by *Nairne and Co.* in London, and there are ſeveral inſtances of ſucceſs attending the

the uſe of them. They are kept in a box, and may be run up and fixed in about five minutes, on the apparent approach of a thunder-guſt.

Of the meeting and ſhocking with other ſhips in the night, I have known two inſtances in voyages between London and America. In one both ſhips arrived though much damaged, each reporting their belief that the other muſt have gone to the bottom. In the other, only one got to port; the other was never afterwards heard of. Theſe inſtances happened many years ago, when the commerce between Europe and America was not a tenth part of what it is at preſent, ſhips of courſe thinner ſcattered, and the chance of meeting proportionably leſs. It has long been the practice to keep a *look-out before* in the channel, but at ſea it has been neglected. If it is not at preſent thought worth while to take that precution, it will in time become of more conſequence; ſince the number of ſhips at ſea is continually augmenting. A drum frequently beat, or a bell rung in a dark night, might help to prevent ſuch accidents.

Iſlands of ice are frequently ſeen off the banks of Newfoundland, by ſhips going between North-America and Europe. In the day-time they are eaſily avoided, unleſs in a very thick fog. I remember two inſtances of ſhips running againſt them in the night. The firſt loſt her bowſprit, but received little other damage. The other ſtruck where the warmth of the ſea had waſted the ice next to it, and a part hung over above. This perhaps ſaved her, for ſhe was under great way;

way; but the upper part of the cliff taking her fore-topmaſt, broke the ſhock, though it carried away the maſt. She diſengaged herſelf with ſome difficulty, and got ſafe into port; but the accident ſhows the poſſibility of other ſhips being wrecked and ſunk by ſtriking thoſe vaſt maſſes of ice, of which I have ſeen one that we judged to be ſeventy feet high above the water, conſequently eight times as much under water; and it is another reaſon for keeping a good *look-out before*, though far from any coaſt that may threaten danger.

It is remarkable that the people we conſider as ſavages, have improved the art of ſailing- and rowing-boats in ſeveral points beyond what we can pretend to. We have no ſailing-boats equal to the flying proas of the South Seas, no rowing or paddling boat equal to that of the Greenlanders for ſwiftneſs and ſafety. The birch canoes of the North-American Indians have alſo ſome advantageous properties. They are ſo light, that two men may carry one of them over land, which is capable of carrying a dozen upon the water; and in heeling they are not ſo ſubject to take in water as our boats, the ſides of which are loweſt in the middle, where it is moſt likely to enter, this being higheſt in that part, as in figure 11.

The Chineſe are an enlightened people, the moſt anciently civilized of any exiſting, and their arts are ancient, a preſumption in their favour: their method of rowing their boats differs

fers from ours, the oars being worked either two a-ſtern as we ſcull, or on the ſides with the ſame kind of motion, being hung parallel to the keel on a rail, and always acting in the water, not perpendicular to the ſide as ours are, nor lifted out at every ſtroke, which is a loſs of time, and the boat in the interval loſes motion. They ſee our manner, and we theirs, but neither are diſpoſed to learn of or copy the other.

To the ſeveral means of moving boats, mentioned above, may be added the ſingular one lately exhibited at Javelle, on the Seine below Paris, where a clumſy boat was moved acroſs that river in three minutes by rowing, not in the water, but in the air, that is, by whirling round a ſet of windmill vanes fixed to a horizontal axis, parallel to the keel, and placed at the head of the boat. The axis was bent into an elbow at the end, by the help of which it was turned by one man at a time. I ſaw the operation at a diſtance. The four vanes appeared to be about five feet long, and perhaps two and a half wide. The weather was calm. The labour appeared to be great for one man, as the two ſeveral times relieved each other. But the action upon the air by the oblique ſurfaces of the vanes muſt have been conſiderable, as the motion of the boat appeared tolerably quick going and returning; and ſhe returned to the ſame place from whence ſhe firſt ſet out, notwithſtanding the current. This machine is

ſince

ſince applied to the moving of air balloons: an inſtrument ſimilar may be contrived to move a boat by turning under water.

Several mechanical projectors have at different times propoſed to give motion to boats, and even to ſhips, by means of circular rowing, or paddles placed on the circumference of wheels to be turned conſtantly on each ſide of the veſſel; but this method, though frequently tried, has never been found ſo effectual as to encourage a continuance of the practice. I do not know that the reaſon has hitherto been given. Perhaps it may be this, that great part of the force employed contributes little to the motion. For inſtance, (fig. 12.) of the four paddles a, b, c, d, all under water, and turning to move a boat from X to Y, c has the moſt power, b nearly, though not quite ſo much, their motion being nearly horizontal; but the force employed in moving a, is conſumed in preſſing almoſt downright upon the water till it comes to the place of b; and the force employed in moving d is conſumed in lifting the water till d arrives at the ſurface; by which means much of the labour is loſt. It is true, that by placing the wheels higher out of the water, this waſte labour will be diminiſhed in a calm, but where a ſea runs, the wheels muſt unavoidably be often dipt deep in the waves, and the turning of them thereby rendered very laborious to little purpoſe.

Among the various means of giving motion

to a boat, that of M. Bernoulli appears one of the moſt ſingular, which was, to have fixed in the boat a tube in the form of an L, the upright part to have a funnel-kind of opening at top, convenient for filling the tube with water; which deſcending and paſſing through the lower horizontal part, and iſſuing in the middle of the ſtern, but under the ſurface of the river, ſhould puſh the boat forward. There is no doubt that the force of the deſcending water would have a conſiderable effect, greater in proportion to the height from which it deſcended; but then it is to be conſidered, that every bucket-full pumped or dipped up into the boat, from its ſide or through its bottom, muſt have its *vis inertiæ* overcome ſo as to receive the motion of the boat, before it can come to give motion by its deſcent; and that will be a deduction from the moving power. To remedy this, I would propoſe the addition of another ſuch L pipe, and that they ſhould ſtand back to back in the boat thus, figure 13; the forward one being worked as a pump, and ſucking in the water at the head of the boat, would draw it forward while puſhed in the ſame direction by the force at the ſtern. And after all, it ſhould be calculated whether the labour of pumping would be leſs than that of rowing. A fire-engine might poſſibly in ſome caſes be applied in this operation with advantage.

Perhaps this labour of raiſing water might be ſpread, and the whole force of a man applied to

to the moving of a boat by the uſe of air inſtead of water. Suppoſe the boat conſtructed in this form, figure 14: A a tube, round or ſquare, of two feet diameter, in which a piſton may move up and down. The piſton to have valves in it, opening inwards, to admit air when the piſton riſes; and ſhutting, when it is forced down by means of the lever B turning on the center C. The tube to have a valve D, to open when the piſton is forced down, and let the air paſs out at E, which ſtriking forcibly againſt the water abaft, muſt puſh the boat forward. If there is added an air-veſſel F, properly valved and placed, the force would continue to act while a freſh ſtroke is taken with the lever. The boatman might ſtand with his back to the ſtern, and putting his hands behind him, work the motion by taking hold of the croſs bar at B, while another ſhould ſteer; or, if he had two ſuch pumps, one on each ſide of the ſtern, with a lever for each hand, he might ſteer himſelf by working occaſionally more or harder with either hand, as watermen now do with a pair of ſculls. There is no poſition in which the body of a man can exert more ſtrength than in pulling right upwards.

To obtain more ſwiftneſs, greaſing the bottom of a veſſel is ſometimes uſed, and with good effect. I do not know that any writer has hitherto attempted to explain this. At firſt ſight one would imagine, that though the friction of a hard body ſliding on another hard

body, and the reſiſtance occaſioned by that friction, might be diminiſhed by putting greaſe between them, yet that a body ſliding on a fluid, ſuch as water, ſhould have no need of, nor receive any advantage from, ſuch greaſing. But the fact is not diſputed: and the reaſon perhaps may be this; the particles of water have a mutual attraction, called the attraction of adheſion. Water alſo adheres to wood, and to many other ſubſtances, but not to greaſe: on the contrary, they have a mutual repulſion, ſo that it is a queſtion whether, when oil is poured on water, they ever actually touch each other; for a drop of oil upon water, inſtead of ſticking to the ſpot where it falls, as it would if it fell on a looking-glaſs, ſpreads inſtantly to an immenſe diſtance in a film extremely thin, which it could not eaſily do if it touched and rubbed, or adhered even in a ſmall degree to the ſurface of the water. Now the adheſive force of water to itſelf, and to other ſubſtances, may be eſtimated from the weight of it neceſſary to ſeparate a drop, which adheres, while growing, till it has weight enough to force the ſeparation and break the drop off. Let us ſuppoſe the drop to be the ſize of a pea, then there will be as many of theſe adheſions as there are drops of that ſize touching the bottom of a veſſel, and theſe muſt be broken by the moving power, every ſtep of her motion that amounts to a drop's breadth: and there being no ſuch adheſions to break be-

tween

tween the water and a greaſed bottom, may occaſion the difference.

So much reſpecting the motion of veſſels. But we have ſometimes occaſion to ſtop their motion; and if a bottom is near enough we can caſt anchor. Where there are no foundings, we have as yet no means to prevent driving in a ſtorm, but by lying-to, which ſtill permits driving at the rate of about two miles an hour; ſo that in a ſtorm, continuing fifty hours, which is not an uncommon caſe, the ſhip may drive one hundred miles out of her courſe; and ſhould ſhe in that diſtance meet with a lee ſhore, ſhe may be loſt.

To prevent this driving to leeward in deep water, a ſwimming anchor is wanting, which ought to have theſe properties.

1. It ſhould have a ſurface ſo large, as being at the end of a hauſer in the water, and placed perpendicularly, ſhould hold ſo much of it, as to bring the ſhip's head to the wind, in which ſituation the wind has leaſt power to drive her.

2. It ſhould be able by its reſiſtance to prevent the ſhip's receiving way.

3. It ſhould be capable of being ſituated below the heave of the ſea, but not below the undertow.

4. It ſhould not take up much room in the ſhip.

5. It ſhould be eaſily thrown out, and put into its proper ſituation.

6. It ſhould be eaſy to take in again, and ſtow away.

An ingenious old mariner, whom I formerly knew, propoſed, as a ſwimming anchor for a large ſhip, to have a ſtem of wood twenty-five feet long and four inches ſquare, with four boards of 18, 16, 14, and 12 feet long, and one foot wide, the boards to have their ſubſtance thickened ſeveral inches in the middle by additional wood, and to have each a four-inch ſquare hole through its middle, to permit its being ſlipt on occaſionally upon the ſtem, and at right angles with it; where all being placed and fixed at four feet diſtance from each other, it would have the appearance of the old mathematical inſtrument called a foreſtaff. This thrown into the ſea, and held by a hauſer veered out to ſome length, he conceived would bring a veſſel up, and prevent her driving, and when taken in might be ſtowed away by ſeparating the boards from the ſtem. Figure 15. Probably ſuch a ſwimming anchor would have ſome good effect; but it is ſubject to this objection, that lying on the ſurface of the ſea, it is liable to be hove forward by every wave, and thereby give ſo much leave for the ſhip to drive.

Two machines for this purpoſe have occurred to me, which though not ſo ſimple as the above, I imagine would be more effectual, and more eaſily manageable. I will endeavour to deſcribe them, that they may be ſubmitted to your judgment, whether either would be ſervice-

able; and if they would, to which we ſhould give the preference.

The firſt is to be formed, and to be uſed in the water on almoſt the ſame principles with thoſe of a paper kite uſed in the air; only as the paper kite riſes in the air, this is to deſcend in the water. Its dimenſions will be different for ſhips of different ſize.

To make one of ſuppoſe fifteen feet high; take a ſmall ſpar of that length for the back-bone, A B, figure 16; a ſmaller of half that length C D, for the croſs piece. Let theſe be united by a bolt at E, yet ſo as that by turning on the bolt they may be laid parallel to each other. Then make a ſail of ſtrong canvas, in the ſhape of figure 17. To form this, without waſte of ſail-cloth, ſew together pieces of the proper length, and for half the breadth, as in figure 18; then cut the whole in the diagonal lines a, b, c, and turn the piece F ſo as to place its broad part oppoſite to that of the piece G, and the piece H in like manner oppoſite to I, which, when all ſewed together, will appear as in figure 17. This ſail is to be extended on the croſs of figure 16, the top and bottom points well ſecured to the ends of the long ſpar; the two ſide points d, e, faſtened to the ends of two cords, which coming from the angle of the loop (which muſt be ſimilar to the loop of a kite) paſs through two rings at the ends of the ſhort ſpar, ſo as that on pulling upon the loop the ſail will be drawn to its extent. The whole

may, when aboard, be furled up, as in figure 19, having a rope from its broad end, to which is tied a bag of ballaſt for keeping that end downwards when in the water, and at the other end another rope, with an empty keg at its end to float on the furface; this rope long enough to permit the kite's deſcending into the undertow, or, if you pleaſe, lower into ſtill water. It ſhould be held by a hauſer. To get it home eaſily, a ſmall looſe rope may be veered out with it, fixed to the keg. Hauling on that rope will bring the kite home with ſmall force, the reſiſtance being ſmall, as it will then come endways.

It ſeems probable that ſuch a kite at the end of a long hauſer would keep a ſhip with her head to the wind, and reſiſting every tug, would prevent her driving ſo faſt as when her ſide is expoſed to it, and nothing to hold her back. If only half the driving is prevented, ſo as that ſhe moves but fifty miles inſtead of the hundred during a ſtorm, it may be ſome advantage, both in holding ſo much diſtance as is ſaved, and in keeping from a lee ſhore. If ſingle canvas ſhould not be found ſtrong enough to bear the tug without ſplitting, it may be doubled, or ſtrengthened by a netting behind it, repreſented by figure 20.

The other machine for the ſame purpoſe, is to be made more in the form of an umbrella, as repreſented, figure 21. The ſtem of the umbrella a ſquare ſpar of proper length, with four moveable arms, of which two are repreſented C, C,

C, C, figure 22. Theſe arms to be fixed in four joint cleats, as D, D, &c. one on each ſide of the ſpar, but ſo as that the four arms may open by turning on a pin in the joint. When open they form a croſs, on which a four-ſquare canvas ſail is to be extended, its corners faſtened to the ends of the four arms. Thoſe ends are alſo to be ſtayed by ropes faſtened to the ſtem or ſpar, ſo as to keep them ſhort of being at right angles with it: and to the end of one of the arms ſhould be hung the ſmall bag of ballaſt, and to the end of the oppoſite arm the empty keg. This, on being thrown into the ſea, would immediately open; and when it had performed its function, and the ſtorm over, a ſmall rope from its other end being pulled on, would turn it, cloſe it, and draw it eaſily home to the ſhip. This machine ſeems more ſimple in its operation, and more eaſily manageable, than the firſt, and perhaps may be as effectual *.

Veſſels are ſometimes retarded, and ſometimes forwarded in their voyages, by currents at ſea, which are often not perceived. About the year 1769 or 70, there was an application made by the board of cuſtoms at Boſton, to the lords of the treaſury in London, complaining that the packets between Falmouth and New-York were generally a fortnight longer in their

* Captain Truxton, on board whoſe ſhip this was written, has executed this propoſed machine: he has given ſix arms to the umbrella; they are joined to the ſtem by iron hinges, and the canvas is double. He has taken it with him to China. February 1786.

paſſages

paſſages than merchant ſhips from London to Rhode-Iſland, and propoſing that for the future they ſhould be ordered to Rhode-Iſland inſtead of New-York. Being then concerned in the management of the American poſt-office, I happened to be conſulted on the occaſion; and it appearing ſtrange to me that there ſhould be ſuch a difference between two places, ſcarce a day's run aſunder, eſpecially when the merchant ſhips are generally deeper laden, and more weakly manned than the packets, and had from London the whole length of the river and channel to run before they left the land of England, while the packets had only to go from Falmouth, I could not but think the fact miſunderſtood or miſrepreſented. There happened then to be in London a Nantucket ſea-captain of my acquaintance, to whom I communicated the affair. He told me he believed the fact might be true; but the difference was owing to this, that the Rhode-Iſland captains were acquainted with the gulph ſtream, which thoſe of the Engliſh packets were not. We are well acquainted with that ſtream, ſays he, becauſe, in our purſuit of whales, which keep near the ſides of it, but are not to be met with in it, we run down along the ſides, and frequently croſs it to change our ſide; and in croſſing it have ſometimes met and ſpoke with thoſe packets, who were in the middle of it, and ſtemming it. We have informed them that they were ſtemming a current, that was againſt them

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REMARKS

Upon the Navigation from NEWFOUNDLAND to NEW YORK In order to avoid the GULPH STREAM

On one hand, and on the other the Shoals *that lie to the Southward of Nantucket and of St. Georges Banks*

After you have passed the Banks of Newfoundland in about the 44th degree of latitude, you will meet with nothing, till you draw near the Isle of Sables, which we commonly pass in latitude 43. Southward of this isle, the current is found to extend itself as far North as 41° 20' or 30' then it turns towards the E. S.E. or S.E. 4 E. Having passed the Isle of Sables, shape your course for the St. George's Banks, so as to pass them in about latitude 40°, because the current southward of those banks reaches as far North as 39°. The shoals of those banks lie in 41° 35'.

After having passed St. George's Banks, you must to clear Nantucket, form your course so as to pass between the latitudes 38° 30' and 40° 45'. The most southern part of the shoals of Nantucket lie in about 40° 45'. The northern part of the current directly to the south of Nantucket is felt in about latitude 38° 30'.

By observing these directions and keeping between the stream and the shoals, the passage from the Banks of Newfoundland to New York, Delaware, or Virginia, may be considerably shortened; for so you will have the advantage of the eddy current, which moves contrary to the Gulf Stream. Whereas if to avoid the shoals you keep too far to the southward, and get into the stream, you will be retarded by it at the rate of 60 or 70 miles a day.

The Nantucket whale-men being extreamly well acquainted with the Gulf Stream, its course, strength and extent, by their constant practice of whaling on the edges of it, from their island quite down to the Bahamas, this draft of that stream was obtained from one of them, Capt: Folger, and caused to be engraved on the old chart in London for the benefit of navigators, by

B. FRANKLIN.

Note, The Nantucket captains who are acquainted with this stream, make their voiages from England to Boston in as short a time generally as others take in going from Boston to England, viz from 20 to 30 days

A stranger may know when he is in the Gulf Stream, by the warmth of the water, which is much greater than that of the water on each side of it. If then he is bound to the westward, he should cross the stream to get out of it as soon as possible.

B. F.

CHART of the GULF STREAM

them to the value of three miles an hour; and adviſed them to croſs it and get out of it; but they were too wiſe to be counſelled by ſimple American fiſhermen. When the winds are but light, he added, they are carried back by the current more than they are forwarded by the wind: and if the wind be good, the ſubtraction of 70 miles a day from their courſe is of ſome importance. I then obſerved, that it was a pity no notice was taken of this current upon the charts, and requeſted him to mark it out for me, which he readily complied with, adding directions for avoiding it in ſailing from Europe to North-America. I procured it to be engraved by order from the general poſt-office, on the old chart of the Atlantic, at Mount and Page's, Tower-hill; and copies were ſent down to Falmouth for the captains of the packets, who ſlighted it however; but it is ſince printed in France, of which edition I hereto annex a copy.

This ſtream is probably generated by the great accumulation of water on the eaſtern coaſt of America between the tropics, by the trade winds which conſtantly blow there. It is known that a large piece of water, ten miles broad and generally only three feet deep, has by a ſtrong wind had its waters driven to one ſide, and ſuſtained ſo as to become ſix feet deep, while the windward ſide was laid dry. This may give ſome idea of the quantity heaped up on the American coaſt, and the reaſon of its running

running down in a ſtrong current through the iſlands into the bay of Mexico, and from thence iſſuing through the gulph of Florida, and proceeding along the coaſt to the banks of Newfoundland, where it turns off towards and runs down through the Weſtern iſlands. Having ſince croſſed this ſtream ſeveral times in paſſing between America and Europe, I have been attentive to ſundry circumſtances relating to it, by which to know when one is in it; and beſides the gulph weed with which it is interſperſed, I find that it is always warmer than the ſea on each ſide of it, and that it does not ſparkle in the night. I annex hereto the obſervations made with the thermometer in two voyages, and poſſibly may add a third: it will appear from them, that the thermometer may be an uſeful inſtrument to a navigator, ſince currents coming from the northward into ſouthern ſeas, will probably be found colder than the water of thoſe ſeas, as the currents from ſouthern ſeas into northern are found warmer. And it is not to be wondered that ſo vaſt a body of deep warm water, ſeveral leagues wide, coming from between the tropics, and iſſuing out of the gulph into the northern ſeas, ſhould retain its warmth longer than the twenty or thirty days required to its paſſing the banks of Newfoundland. The quantity is too great, and it is too deep to be ſuddenly cooled by paſſing under a cooler air. The air immediately over it,

it, however, may receive ſo much warmth from it as to be rarefied and riſe, being rendered lighter than the air on each ſide of the ſtream; hence thoſe airs muſt flow in to ſupply the place of the riſing warm air, and meeting with each other, form thoſe tornados and water-ſpouts frequently met with, and ſeen near and over the ſtream; and as the vapour from a cup of tea in a warm room, and the breath of an animal in the ſame room, are hardly viſible, but become ſenſible immediately when out in the cold air, ſo the vapour from the gulph ſtream, in warm latitudes, is ſcarcely viſible, but when it comes into the cool air from Newfoundland, it is condenſed into the fogs, for which thoſe parts are ſo remarkable.

The power of wind to raiſe water above its common level in the ſea, is known to us in America, by the high tides occaſioned in all our ſea-ports when a ſtrong north-eaſter blows againſt the gulph ſtream.

The concluſion from theſe remarks is, that a veſſel from Europe to North-America may ſhorten her paſſage by avoiding to ſtem the ſtream, in which the thermometer will be very uſeful; and a veſſel from America to Europe may do the ſame by the ſame means of keeping in it. It may have often happened accidentally, that voyages have been ſhortened by theſe circumſtances. It is well to have the command of them.

But may there not be another cauſe, independent of winds and currents, why paſſages are generally ſhorter from America to Europe than from Europe to America? This queſtion I formerly conſidered in the following ſhort paper.

On board the Pennſylvania Packet, Capt. Oſborne, at ſea, April 5, 1775.

" Suppoſe a ſhip to make a voyage eaſtward from a place in lat. 40° north, to place in lat. 50° north, diſtance in longitude 75 degrees.

" In ſailing from 40 to 50, ſhe goes from a place where a degree of longitude is about eight miles greater than in the place ſhe is going to. A degree is equal to four minutes of time; conſequently the ſhip in the harbour ſhe leaves, partaking of the diurnal motion of the earth, moves two miles in a minute faſter than when in the port ſhe is going to; which is 120 miles in an hour.

" This motion in a ſhip and cargo is of great force; and if ſhe could be lifted up ſuddenly from the harbour in which ſhe lay quiet, and ſet down inſtantly in the latitude of the port ſhe was bound to, though in a calm, that force contained in her would make her run a great way at a prodigious rate. This force muſt be loſt gradually in her voyage, by gradual impulſe againſt the water, and probably thence ſhorten the voyage. Query, In returning does the

the contrary happen, and is her voyage thereby retarded and lengthened * ?"

Would it not be a more ſecure method of planking ſhips, if, inſtead of thick ſingle planks laid horizontally, we were to uſe planks of half the thickneſs, and lay them double and acroſs each other, as in figure 23? To me it ſeems that the difference of expence would not be conſiderable, and that the ſhip would be both tighter and ſtronger.

The ſecuring of the ſhip is not the only neceſſary thing; ſecuring the health of the ſailors, a brave and valuable order of men, is likewiſe of great importance. With this view the methods ſo ſucceſsfully practiſed by Captain Cook in his long voyages, cannot be too cloſely ſtudied or carefully imitated. A full account of thoſe methods is found in Sir John Pringle's ſpeech, when the medal of the Royal Society was given to that illuſtrious navigator. I am glad to ſee, in his laſt voyage, that he found the means effectual which I had propoſed for preſerving flour, bread, &c. from moiſture and damage. They were found dry and good after being at ſea four years. The method is deſcribed in my printed works, page 452, fifth edition. In the ſame, page 469, 470, is propoſed a means of allaying thirſt in caſe of want of freſh water. This has ſince been practiſed

* Since this paper was read at the Society, an ingenious member, Mr. Patterſon, has convinced the writer that the returning voyage would not, from this cauſe, be retarded.

in

in two inſtances with ſucceſs. Happy if their hunger, when the other proviſions are conſumed, could be relieved as commodiouſly; and perhaps in time this may be found not impoſſible. An addition might be made to their preſent vegetable proviſion, by drying various roots in ſlices by the means of an oven. The ſweet potatoe of America and Spain is excellent for this purpoſe. Other potatoes, with carrots, parſnips, and turnips, might be prepared and preſerved in the ſame manner.

With regard to make-ſhifts in caſes of neceſſity, ſeamen are generally very ingenious themſelves. They will excuſe however the mention of two or three. If they happen in any circumſtance, ſuch as after ſhipwreck, taking to their boat, or the like, to want a compaſs, a fine ſewing-needle, laid on clear water in a cup, will generally point to the north, moſt of them being a little magnetical, or may be made ſo by being ſtrongly rubbed or hammered, lying in a north and ſouth direction. If their needle is too heavy to float by itſelf, it may be ſupported by little pieces of cork or wood. A man who can ſwim, may be aided in a long traverſe by his handkerchief formed into a kite, by two croſs ſticks extending to the four corners; which being raiſed in the air, when the wind is fair and freſh, will tow him along while lying on his back. Where force is wanted to move a heavy body, and there are but few hands and no machines, a long and ſtrong

ſtrong rope may make a powerful inſtrument. Suppoſe a boat is to be drawn up on a beach, that ſhe may be out of the ſurf, a ſtake drove into the beach where you would have the boat drawn, and another to faſten the end of the rope to, which comes from the boat, and then applying what force you have to pull upon the middle of the rope at right angles with it, the power will be augmented in proportion to the length of rope between the poſts. The rope being faſtened to the ſtake A, and drawn upon in the direction C D, will ſlide over the ſtake B; and when the rope is bent to the angle A D B, repreſented by the pricked line in figure 24, the boat will be at B.

Some ſailors may think the writer has given himſelf unneceſſary trouble in pretending to adviſe them; for they have a little repugnance to the advice of landmen, whom they eſteem ignorant and incapable of giving any worth notice; though it is certain that moſt of their inſtruments were the invention of landmen: at leaſt the firſt veſſel ever made to go on the water was certainly ſuch. I will therefore add only a few words more, and they ſhall be addreſſed to paſſengers.

When you intend a long voyage, you may do well to keep your intention as much as poſſible a ſecret, or at leaſt the time of your departure; otherwiſe you will be continually interrupted in your preparations by the viſits of friends and acquaintance, who will not only rob you

of the time you want, but put things out of your mind, ſo that when you come to ſea, you have the mortification to recollect points of buſineſs that ought to have been done, accounts you had intended to ſettle, and conveniencies you had propoſed to bring with you, &c. &c. all which have been omitted through the effect of theſe officious friendly viſits. Would it not be well if this cuſtom could be changed; if the voyager, after having, without interruption, made all his preparations, ſhould uſe ſome of the time he has left, in going himſelf to take leave of his friends at their own houſes, and let them come to congratulate him on his happy return?

It is not always in your power to make a choice in your captain, though much of your comfort in the paſſage may depend on his perſonal character, as you muſt for ſo long a time be confined to his company, and under his direction; if he be a ſenſible, ſociable, good-natured, obliging man, you will be ſo much the happier. Such there are; but if he happens to be otherwiſe, and is only ſkilful, careful, watchful, and active in the conduct of his ſhip, excuſe the reſt, for theſe are the eſſentials.

Whatever right you may have by agreement in the maſs of ſtores laid in by him for the paſſengers, it is good to have ſome particular things in your own poſſeſſion, ſo as to be always at your own command.

1. Good water, that of the ſhip being often

bad. You can be ſure of having it good only by bottling it from a clear ſpring or well, and in clean bottles. 2. Good tea. 3. Coffee ground. 4. Chocolate. 5. Wine of the ſort you particularly like, and cyder. 6. Raiſins. 7. Almonds. 8. Sugar. 9. Capillaire. 10. Lemons. 11. Jamaica ſpirits. 12. Eggs greas'd. 13. Diet-bread. 14. Portable ſoup. 15. Ruſks. As to fowls, it is not worth while to have any called yours, unleſs you could have the feeding and managing of them, according to your own judgment, under your own eye. As they are generally treated at preſent in ſhips, they are for the moſt part ſick, and their fleſh tough and hard as whit-leather. All ſeamen have an opinion, broached I ſuppoſed at firſt prudently, for ſaving of water when ſhort, that fowls do not know when they have drank enough, and will kill themſelves if you give them too much, ſo they are ſerved with a little only once in two days. This is poured into troughs that lie ſloping, and therefore immediately runs down to the lower end. There the fowls ride upon one another's backs to get at it, and ſome are not happy enough to reach and once dip their bills in it. Thus tantalized, and tormented with thirſt, they cannot digeſt their dry food, they fret, pine, ſicken, and die. Some are found dead, and thrown overboard every morning, and thoſe killed for the table are not eatable. Their troughs ſhould be in little diviſions like cups, to hold the water ſeparately, figure 25. But this

is never done. The ſheep and hogs are therefore your beſt dependance for freſh meat at ſea, the mutton being generally tolerable, and the pork excellent.

It is poſſible your captain may have provided ſo well in the general ſtores, as to render ſome of the particulars above recommended of little or no uſe to you. But there are frequently in the ſhip poorer paſſengers, who are taken at a lower price, lodge in the ſteerage, and have no claim to any of the cabin proviſions, or to any but thoſe kinds that are allowed the ſailors. Theſe people are ſometimes dejected, ſometimes ſick; there may be women and children among them. In a ſituation where there is no going to market to purchaſe ſuch neceſſaries, a few of theſe your ſuperfluities, diſtributed occaſionally, may be of great ſervice, reſtore health, ſave life, make the miſerable happy, and thereby afford you infinite pleaſure.

The worſt thing in ordinary merchant ſhips is the cookery. They have no profeſſed cook, and the worſt hand as a ſeaman is appointed to that office, in which he is not only very ignorant but very dirty. The ſailors have therefore a ſaying, that *God ſends meat and the devil cooks*. Paſſengers more piouſly diſpoſed, and willing to believe Heaven orders all things for the beſt, may ſuppoſe, that knowing the ſea-air and conſtant exerciſe by the motion of the veſſel would give us extraordinary appetites, bad cooks were kindly

kindly ſent to prevent our eating too much; or that, foreſeeing we ſhould have bad cooks, good appetites were furniſhed to prevent our ſtarving. If you cannot truſt to theſe circumſtances, a ſpirit-lamp, with a blaze-pan, may enable you to cook ſome little things for yourſelf; ſuch as a haſh, a ſoup, &c. And it might be well alſo to have among your ſtores ſome potted meats, which, if well put up, will keep long good. A ſmall tin-oven, to place with the open ſide before the fire, may be another good utenſil, in which your own ſervant may roaſt for you a bit of pork or mutton. You will ſometimes be induced to eat of the ſhip's ſalt beef, as it is often good. You will find cyder the beſt quencher of that thirſt which ſalt meat or fiſh occaſions. The ſhip biſcuit is too hard for ſome ſets of teeth. It may be ſoftened by toaſting. But ruſk is better; for being made of good fermented bread, ſliced and baked a ſecond time, the pieces imbibe the water eaſily, ſoften immediately, digeſt more kindly, and are therefore more wholeſome than the unfermented biſcuit. By the way, ruſk is the true original biſcuit, ſo prepared to keep for ſea, biſcuit in French ſignifying twice baked. If your dry peas boil hard, a two-pound iron ſhot put with them into the pot will, by the motion of the ſhip, grind them as fine as muſtard.

The accidents I have ſeen at ſea with large diſhes of ſoup upon a table, from the motion of the ſhip, have made me wiſh that our pot-

ters or pewterers would make ſoup-diſhes in diviſions, like a ſet of ſmall bowls united together, each containing about ſufficient for one perſon, in ſome ſuch form as fig. 26; for then, when the ſhip ſhould make a ſudden heel, the ſoup would not in a body flow over one ſide, and fall into people's laps and ſcald them, as is ſometimes the caſe, but would be retained in the ſeparate diviſions, as in figure 27.

After theſe trifles, permit the addition of a few general reflections. Navigation, when employed in ſupplying neceſſary proviſions to a country in want, and thereby preventing famines, which were more frequent and deſtructive before the invention of that art, is undoubtedly a bleſſing to mankind. When employed merely in tranſporting ſuperfluities, it is a queſtion whether the advantage of the employment it affords is equal to the miſchief of hazarding ſo many lives on the ocean; but when employed in pillaging merchants and tranſporting ſlaves, it is clearly the means of augmenting the maſs of human miſery. It is amazing to think of the ſhips and lives riſqued in fetching tea from China, coffee from Arabia, ſugar and tobacco from America, all which our anceſtors did well without. Sugar employs near one thouſand ſhips, tobacco almoſt as many. For the utility of tobacco there is little to be ſaid; and for that of ſugar, how much more commendable would it be if we could give up the few minutes gratification afforded

once

once or twice a day by the taſte of ſugar in our tea, rather than encourage the cruelties exerciſed in producing it. An eminent French moraliſt ſays, that when he conſiders the wars we excite in Africa to obtain ſlaves, the numbers neceſſarily ſlain in thoſe wars, the many priſoners who periſh at ſea by ſickneſs, bad proviſions, foul air, &c. &c. in the tranſportation, and how many afterwards die from the hardſhips of ſlavery, he cannot look on a piece of ſugar without conceiving it ſtained with ſpots of human blood! Had he added the conſideration of the wars we make to take and retake the ſugar iſlands from one another, and the fleets and armies that periſh in thoſe expeditions, he might have ſeen his ſugar not merely ſpotted, but thoroughly dyed ſcarlet in grain. It is theſe wars that make the maritime powers of Europe, the inhabitants of London and Paris, pay dearer for ſugar than thoſe of Vienna, a thouſand miles from the ſea; becauſe their ſugar coſts not only the price they pay for it by the pound, but all they pay in taxes to maintain the fleets and armies that fight for it.

With great eſteem, I am, Sir,

Your moſt obedient humble ſervant,

B. FRANKLIN.

Obſervations of the warmth of the ſea-water, &c. by Fahrenheit's thermometer, in croſſing the Gulph ſtream; with other remarks made on board the Pennſylvania packet, Captain Oſborne, bound from London to Philadelphia, in April and May 1775.

Date.	Hour.	Temp. of Air.	Temp. of Water.	Wind.	Courſe.	Diſtance.	Latitude N.	Longitude W.	Remarks.
April 10			62						
11			61						
12			64						
13			65						
14			65				° ′	° ′	
26		60	70	—	—	—	37 39	60 38	Much gulph weed; ſaw a whale.
27		60	70	S S E	W b S	—	37 13	62 29	Colour of water changed.
28	8 A. M.	70	64	S W	W N W	—	37 48	64 35	No gulph weed.
—	6 P. M.	67	60	—	—	34	—	—	Sounded, no bottom.
29	8 A. M.	63	71	N	W	44	37 26	66 0	Much light in the water laſt night.
—	5 P. M.	65	72	N E	—				Water again of the uſual deep ſea
—	11 dit.	66	66	N W b N	W b S	57	—	—	colour, little or no light in it at
30	8 A. M.	64	70	N E	W b N	69	—	—	night.
—	12	62	70	—	E b S	24	37 20	68 53	Frequent gulph weed, water con-
—	6 P. M.	64	72	E S E	W b N	43	—	—	tinues of ſea colour, little light.
—	10 dit.	65	65	S	—	25	—	—	Much light.
May 1	7 A. M.	68	63	—	—	60	—	—	Much light all laſt night.
—	12	65	56	S S W	W N W	44	38 13	72 23	Colour of water changed.
—	4 P. M.	64	56	—	W b N	21			
—	10 dit.	64	57	S W	W N W	31	—	—	Much light.
2	8 A. M.	62	53	—	—	18	38 43	74 3	Much light. Thunder-guſt.
—	12	60	53	W S W	N W	18			
—	6 P. M.	64	55	N W	W S W	15			
—	10 dit.	65	55	N b W	W b N	10			
3	7 A. M.	62	54	—	—	30	38 30	75 0	

Obſervations

Obſervations of the warmth of the ſea-water, &c. by Fahrenheit's thermometer; with other remarks made on board the Repriſal, Captain Wycks, bound from Philadelphia to France, in October and November 1776.

Date.	Hour A. M.	Hour P. M.	Temp. of Air.	Temp. of Water.	Wind.	Courſe.	Diſtance.	Latitude N.	Longitude W.	Remarks.
Oct. 31	10	4	76	70	S S E	E b S	135	38 12	70 30	Left the capes Thurſday night, October 29, 1776.
				71						
Nov. 1	10			78	W S W	E ½ N	109	No ob.	68 12	
		4	71	81						
2	8		71	75	N					
	12			78			141	Ditto	65 23	
		4	67	76						Some ſparks in the water theſe two laſt nights.
3	8			76	N W	E S E ½ E				
	12			76		E b S	160	37 0	62 7	
		4	70	76						
4	9		68	76		N b E				Ditto.
		1		76			194	36 26	58 8	
		4	68	76						
		8		78						
5	8		68	76		N E				Ditto.
	12		70	75			163	35 21	55 3	
		4		75						
		8		75						
6	8			76	E b N	S 50 E				
	12			77			75	35 33	53 52	
7	8			78	S E b E	N 30 W				
	12			77			108	36 6	52 46	
		4		77						
8	9		75	77	S b E	N 49 E				
	12			77			175	38 2	50 1	
		4		77						
9	9		75	77						
	12		75	70	S W	N 33 E	175	39 39	46 55	

Observations made on board the Repriſal, continued.

Date.	Hour A. M.	Hour P. M.	Temp. of Air.	Temp. of Water.	Wind.	Courſe.	Diſtance.	Latitude N.	Longitude W.	Remarks.
Novem. 9		4		71						
10	8		70	68						
—	12			64	E	N 17 E	64	40 39	46 27	
11	8			63						
—	12			61	S E	N 8 E	41	41 19	46 19	
12	8		56	59						
—		4		69	N N W	N 80 E	120	41 39	43 42	
13	all day			68	E	S 82 E	69	41 29	42 10	
14	8		70	70		N 74 E	111	42 0	39 57	
—		Noon		72	E S E					
		4		71						
15	8		61	69						
—		Noon		68	W S W	N 70 E	186	43 3	35 51	
		4		67						
16		Noon	65	67	S W	N 67 W	48	43 22	34 50	
—		4		63						
17	8			63	E S E	N 19 E	56	44 15	34 25	
18	all day			65	S b W	N 75 E	210	45 6	29 43	Some gulph weed
19		Noon	65	64	S W	N 80 E	238	45 46	24 2	
20	8			62	N	S 80 E	155	45 19	20 30	
—		4		60						
21	9			62	S	N 88 E	94	45 22	18 17	
22	10		60	62	S S W	S 89 E	133	45 19	15 19	
23		Noon		61	W S W	S 86 E	194	45 6	10 35	
24		do.		60	N N E	N 78 E	191	45 46	6 10	
25		do.		60	N E	S 76 E	125	45 4	3 23	
26		do.	56	60	E	N 73 E	31	45 13	2 20	
27		do.		58						Soundings off Belliſle.
28		do.	54	56						

1785

1785. A Journal of a Voyage from the Channel between France and England towards America.

Dates.	Latit. N.	Long. W.	Therm. A. M. Air.	Therm. A. M. Water.	Therm. P. M. Air.	Therm. P. M. Water.	Winds.	Course.	Distance.	Variation of the Needle.
July 29	——	——	62	57			{ These are taken on an average of 24 hours. }			
30	——	——	62	58	63	58				
31	——	——	60	58	62	62			Miles.	West.
August 1	49 15	4 15	63	62	60	64	East	S W ½ W	60	22° 0′
2	48 28	8 58	64	64	64	63	E S E	W b S ½ S	174	
3	47 0	12 13	60	67	omitted.		N E	S W b W	160	
4	45 0	15 43	66	66	do.	66	N W b W	S W ½ W	190	
5	43 5	17 25	67	65	65	68	N E	S W b S	131	20 0
6	41 3	19 44	70	68	71	69	N E	S W ½ S	166	16 30
7	38 45	21 34	70	70	68	70	N E	S S W ¼ W	165	11 30
8	36 42	23 10	72	71	73	72	N E	S S W ½ W	149	11 15
9	35 40	25 40	73	73	73	74	N E	W S W ¼ S	137	
10	35 0	27 0	71	73	77	75	N W	W S W ½ S	76	
11	33 51	28 42	74	74	76	77	North	S W ¾ W	112	
12	33 30	31 30	76	75	76	76	North	W ¾ S	143	
13	33 17	33 32	76	76	78	77	N E	W ¼ S	103	——
14	33 22	34 31	76	76	81	79	S S E	W ½ N	50	——
15	33 45	35 0	78	79	79	78	W N W	S W ¼ W	35	——
16	34 14	35 30	79	78	81	80	West	N W ½ N	38	——
17	35 37	36 4	80	79	80	78	W S W	N N W	75	——
18	36 7	37 16	80	78	omitted.		N W b W	W N W ¼ N	65	——
19	36 38	38 0	78	77	78	77	W S W	N W ½ W	49	——
20	37 38	38 6	78	76	omitted.		West	N ¼ W	62	——

Therm. Noon. A	Therm. Noon. W.
77	78
81	79
79	79
81	80
80	78
80	79
79	77
77	75

N. B. Longitude is reckoned from London, and the Thermometer is according to Fahrenheit.

1785. A Journal of a Voyage from the Channel, &c. continued.

Dates.	Lat. N.	Long. W.	Therm. A. M. Air.	Therm. A. M. Water.	Therm. P. M. Air.	Therm. P. M. Water.	Winds.	Course.	Distance.	Variation of the Needle.	Therm. Noon.	
									Miles.	West.		
August 21	36 15	38 26	73	74	78	76	W N W	S b W	82		77	75
22	35 40	38 44	77	76	80	77	W b S	S S W	38		80	77
23	35 35	40 52	79	77	78	75	North	W ¼ S	100		omitted.	
24	35 12	41 31	75	73	75	74	W N W	S W b W	41		75	74
25	35 40	42 33	79	76	79	76	W b N	W N W ¾ N	60		80	76
26	35 30	42 44	79	76	80	76	S W b W	S W ½ S	14		80	76
27	35 14	43 23	79	77	81	79	West	W S W ¼ S	38		81	78
28	34 23	44 0	78	76	78	78	N N E	S W b S	60		78	78
29	34 12	45 52	77	78	78	78	N E	W ½ S	94	8 °	79	78
30	34 5	48 31	78	78	78	78	East	W ½ S	134		78	78
31	34 20	51 4	80	79	81	79	East	W ¼ S	129		80	80
September 1	34 20	52 47	81	78	omitted.		S S W	W ¼ N	86		83	80
2	34 55	55 12	81	80	83	80	S W	W b N ½ W	125		83	80
3	35 30	57 24	83	80	83	80	S W b S	W b N ½ N	114	6 °	84	81
4	35 50	59 1	82	80	83	80	S W ½ W	W b N ¼ N	82		83	81
5	35 55	61 0	81	80	82	81	S S W	W ¼ N	96		82	81
6	36 20	62 30	80	81	79	80	N W b N	W b N	75		78	80
7	34 50	63 10	87	80	78	81	N W b W	S S W	86		78	81
8	34 45	64 40	75	79	75	79	North	W ¼ S	74		75	79
9	35 43	66 42	75	79	77	73	N E	W N W	108		78	80
10	37 20	68 40	77	73	77	70	E N E	N W	126		78	72

N. B. Longitude is reckoned from London, and the Thermometer is according to Fahrenheit.

OBSER-

OBSERVATIONS.

July 31. At one P. M. the Start bore W N W. diſtant ſix leagues.
Auguſt 1. The water appears luminous in the ſhip's wake.
— 2. The temperature of the water is taken at eight in the morning and at eight in the evening.
— 6. The water appears leſs luminous.
— 7. Formegas S W. diſt. 32 ½ deg. St. Mary's S W ½ S 33 leagues.
— 8. From this date the temperature of the water is taken at eight in the morning, and at ſix in the evening.
— 10. Moonlight, which prevents the luminous appearance of the water.
— 11. A ſtrong ſoutherly current.
— 12. Ditto. From this date the temperature of the air and water was taken at noon, as well as morning and evening.
— 16. Northerly current.
— 19. Firſt ſaw gulph weed.
— 21. Southerly current.
— 22. Again ſaw gulph weed.
— 24. The water appeared luminous in a ſmall degree, before the moon roſe.
— 29. No moon, yet very little light in the water.
— 30. Much gulph weed to-day.
— 31. Ditto.
Sept. 1. Ditto.
— 2. A little more light in the water.
— 4. No gulph weed to-day. More light in the water.
— 5. Some gulph weed again.
— 6. Little light in the water. A very hard thunder-guſt in the night.
— 7. Little gulph weed.
— 8. More light in the water. Little gulph weed.
— 9. Little gulph weed. Little light in the water laſt evening.
— 10. Saw ſome beds of rock-weed; and we were ſurpriſed to obſerve the water ſix degrees colder by the thermometer than the preceding noon.

This day (10th) the thermometer ſtill kept deſcending, and at five in the morning of the 11th, it was in water as low as 70, when we ſtruck ſoundings. The ſame evening the pilot came on board, and we found our ſhip about five degrees of longitude a-head of the reckoning, which our captain accounted for by ſuppoſing our courſe to have been near the edge of the gulph ſtream, and thus an eddy-current always in our favour. By the diſtance we ran from Sept. 9, in the evening, till we ſtruck ſoundings, we muſt have then been at the weſtern edge of the gulph ſtream, and the change in the temperature of the water was probably owing to our ſuddenly paſſing from that current into the waters of our own climate.

On the 14th of Auguſt the following experiment was made. The weather being perfectly calm, an empty bottle, corked very tight, was ſent down 20 fathoms, and it was drawn up ſtill empty. It was then ſent down again 35 fathoms, when the weight of the water having forced in the cork, it was drawn up full; the water it contained was immediately tried by the thermometer, and found to be 70, which was ſix degrees colder than at the ſurface: The lead and bottle were viſible, but not very diſtinctly ſo, at the depth of 12 fathoms; but when only 7 fathoms deep, they were perfectly ſeen from the ſhip. This experiment was thus repeated September 11, when we were in ſoundings of 18 fathoms. A keg was previouſly prepared with a valve at each end; one opening inward, the other outward: this was ſent to the bottom, in expectation that by the valves being both open when going down,

down, and both ſhut when coming up, it would keep within it the water received at bottom. The upper valve performed its office well, but the under one did not ſhut quite cloſe, ſo that much of the water was loſt in hauling it up the ſhip's ſide. As the water in the keg's paſſage upwards could not enter at the top, it was concluded that what water remained in it was of that near the ground; and on trying this by the thermometer, it was found to be at 58, which was 12 degrees colder than at the ſurface.

This laſt Journal was obligingly kept for me by Mr. J. Williams, my fellow-paſſenger in the London Packet, who made all the experiments with great exactneſs.

INFORMATION

INFORMATION
TO
THOSE WHO WOULD REMOVE
TO
AMERICA.

MANY perſons in Europe having, directly or by letters, expreſſed to the writer of this, who is well acquainted with North-America, their deſire of tranſporting and eſtabliſhing themſelves in that country; but who appear to him to have formed, through ignorance, miſtaken ideas and expectations of what is to be obtained there; he thinks it may be uſeful, and prevent inconvenient, expenſive, and fruitleſs removals and voyages of improper perſons, if he gives ſome clearer and truer notions of that part of the world than appear to have hitherto prevailed.

He finds it is imagined by numbers, that the inhabitants of North-America are rich, capable of rewarding, and diſpoſed to reward all ſorts of ingenuity; that they are at the ſame time ignorant of all the ſciences, and conſequently that ſtrangers, poſſeſſing talents in the belles-lettres, fine arts, &c. muſt be highly eſteemed, and ſo well paid as to become eaſily rich themſelves; that there are alſo abundance

of

of profitable offices to be diſpoſed of, which the natives are not qualified to fill; and that having few perſons of family among them, ſtrangers of birth muſt be greatly reſpected, and of courſe eaſily obtain the beſt of thoſe offices, which will make all their fortunes: that the governments too, to encourage emigrations from Europe, not only pay the expence of perſonal tranſportation, but give lands gratis to ſtrangers, with negroes to work for them, utenſils of huſbandry, and ſtocks of cattle. Theſe are all wild imaginations; and thoſe who go to America with expectations founded upon them, will ſurely find themſelves diſappointed.

The truth is, that though there are in that country few people ſo miſerable as the poor of Europe, there are alſo very few that in Europe would be called rich: it is rather a general happy mediocrity that prevails. There are few great proprietors of the ſoil, and few tenants; moſt people cultivate their own lands, or follow ſome handicraft or merchandiſe; very few rich enough to live idly upon their rents or incomes, or to pay the high prices given in Europe for painting, ſtatues, architecture, and the other works of art that are more curious than uſeful. Hence the natural geniuſes that have ariſen in America, with ſuch talents, have uniformly quitted that country for Europe, where they can be more ſuitably rewarded. It is true that letters and mathematical knowledge are in eſteem there, but they are at the ſame time

time more common than is apprehended; there being already exiſting nine colleges, or univerſities, viz. four in New-England, and one in each of the provinces of New-York, New-Jerſey, Pennſilvania, Maryland, and Virginia, all furniſhed with learned Profeſſors; beſides a number of ſmaller academies: theſe educate many of their youth in the languages, and thoſe ſciences that qualify men for the profeſſions of divinity, law, or phyſic. Strangers indeed are by no means excluded from exerciſing thoſe profeſſions; and the quick increaſe of inhabitants every where gives them a chance of employ, which they have in common with the natives. Of civil offices or employments, there are few; no ſuperfluous ones as in Europe; and it is a rule eſtabliſhed in ſome of the States, that no office ſhould be ſo profitable as to make it deſirable. The 36th article of the conſtitution of Pennſilvania runs expreſsly in theſe words: "As every freeman, to preſerve his independence (if he has not a ſufficient eſtate) ought "to have ſome profeſſion, calling, trade, or "farm, whereby he may honeſtly ſubſiſt, there "can be no neceſſity for, nor uſe in, eſtabliſhing offices of profit; the uſual effects "of which are dependence and ſervility, "unbecoming freemen, in the poſſeſſors and "expectants; faction, contention, corruption, "and diſorder among the people. Wherefore, whenever an office, through increaſe "of fees or otherwiſe, becomes ſo profitable

" as to occaſion many to apply for it, the pro-
" fits ought to be leſſened by the legiſlature."

Theſe ideas prevailing more or leſs in all the United States, it cannot be worth any man's while, who has a means of living at home, to expatriate himſelf in hopes of obtaining a profitable civil office in America; and as to military offices, they are at an end with the war, the armies being diſbanded. Much leſs is it adviſeable for a perſon to go thither who has no other quality to recommend him but his birth. In Europe it has indeed its value; but it is a commodity that cannot be carried to a worſe market than to that of America, where people do not enquire concerning a ſtranger, *What is he?* but *What can he do?* If he has any uſeful art, he is welcome; and if he exerciſes it, and behaves well, he will be reſpected by all that know him; but a mere man of quality, who on that account wants to live upon the public, by ſome office or ſalary, will be deſpiſed and diſregarded. The huſbandman is in honour there, and even the mechanic, becauſe their employments are uſeful. The people have a ſaying, that God Almighty is himſelf a mechanic, the greateſt in the univerſe; and he is reſpected and admired more for the variety, ingenuity, and utility of his handiworks, than for the antiquity of his family. They are pleaſed with the obſervation of a negro, and frequently mention it, that Boccarorra (meaning the white man) make de black man workee,

make de horſe workee, make de ox workee, make ebery ting workee; only de hog. He de hog, no workee; he eat, he drink, he walk about, he go to ſleep when he pleaſe, he libb like a gentleman. According to theſe opinions of the Americans, one of them would think himſelf more obliged to a genealogiſt, who could prove for him that his anceſtors and relations for ten generations had been ploughmen, ſmiths, carpenters, turners, weavers, tanners, or even ſhoemakers, and conſequently that they were uſeful members of ſociety; than if he could only prove that they were gentlemen, doing nothing of value, but living idly on the labour of others, mere *fruges conſumere nati* *, and otherwiſe *good* for *nothing*, till by by their death, their eſtates, like the carcaſe of the negro's gentleman-hog, come to be *cut up*.

With regard to encouragements for ſtrangers from government, they are really only what are derived from good laws and liberty. Strangers are welcome becauſe there is room enough for them all, and therefore the old inhabitants are not jealous of them; the laws protect them ſufficiently, ſo that they have no need of the patronage of great men; and every one will enjoy ſecurely the profits of his induſtry. But if he does not bring a fortune with him, he muſt work and be induſtrious to live. One or two

* There are a number of us born
Merely to eat up the corn. WATTS.

years reſidence give him all the rights of a citizen; but the government does not at preſent, whatever it may have done in former times, hire people to become ſettlers, by paying their paſſages, giving land, negroes, utenſils, ſtock, or any other kind of emolument whatſoever. In ſhort, America is the land of labour, and by no means what the Engliſh call *Lubberland*, and the French *Pays de Cocagne*, where the ſtreets are ſaid to be paved with half-peck loaves, the houſes tiled with pancakes, and where the fowls fly about ready roaſted, crying, *Come eat me!*

Who then are the kind of perſons to whom an emigration to America may be advantageous? And what are the advantages they may reaſonably expect?

Land being cheap in that country, from the vaſt foreſts ſtill void of inhabitants, and not likely to be occupied in an age to come, inſomuch that the propriety of an hundred acres of fertile ſoil full of wood may be obtained near the frontiers, in many places, for eight or ten guineas, hearty young labouring men, who underſtand the huſbandry of corn and cattle, which is nearly the ſame in that country as in Europe, may eaſily eſtabliſh themſelves there. A little money ſaved of the good wages they receive there while they work for others, enables them to buy the land and begin their plantation, in which they are aſſiſted by the good will of their neighbours, and ſome credit. Multitudes

of poor people from England, Ireland, Scotland, and Germany, have by this means in a few years become wealthy farmers, who in their own countries, where all the lands are fully occupied, and the wages of labour low, could never have emerged from the mean condition wherein they were born.

From the ſalubrity of the air, the healthineſs of the climate, the plenty of good proviſions, and the encouragement to early marriages, by the certainty of ſubſiſtence in cultivating the earth, the increaſe of inhabitants by natural generation is very rapid in America, and becomes ſtill more ſo by the acceſſion of ſtrangers; hence there is a continual demand for more artiſans of all the neceſſary and uſeful kinds, to ſupply thoſe cultivators of the earth with houſes, and with furniture and utenſils of the groſſer ſorts, which cannot ſo well be brought from Europe. Tolerably good workmen in any of thoſe mechanic arts, are ſure to find employ, and to be well paid for their work, there being no reſtraints preventing ſtrangers from exerciſing any art they underſtand, nor any permiſſion neceſſary. If they are poor, they begin firſt as ſervants or journeymen; and if they are ſober, induſtrious, and frugal, they ſoon become maſters, eſtabliſh themſelves in buſineſs, marry, raiſe familes, and become reſpectable citizens.

Alſo, perſons of moderate fortunes and capitals, who having a number of children to provide for, are deſirous of bringing them up

to induſtry, and to ſecure eſtates for their poſterity, have opportunities of doing it in America, which Europe does not afford. There they may be taught and practiſe profitable mechanic arts, without incurring diſgrace on that account; but on the contrary acquiring reſpect by ſuch abilities. There ſmall capitals laid out in lands, which daily become more valuable by the increaſe of people, afford a ſolid proſpect of ample fortunes thereafter for thoſe children. The writer of this has known ſeveral inſtances of large tracts of land, bought on what was then the frontier of Pennſilvania, for ten pounds per hundred acres, which, after twenty years, when the ſettlements had been extended far beyond them, ſold readily, without any improvement made upon them, for three pounds per acre. The acre in America is the ſame with the Engliſh acre, or the acre of Normandy.

Thoſe who deſire to underſtand the ſtate of government in America, would do well to read the conſtitutions of the ſeveral ſtates, and the articles of confederation that bind the whole together for general purpoſes, under the direction of one aſſembly called the Congreſs. Theſe conſtitutions have been printed by order of Congreſs, in America; two editions of them have alſo been printed in London; and a good tranſlation of them into French, has lately been publiſhed at Paris.

Several of the princes of Europe having of late, from an opinion of advantage to ariſe by producing

producing all commodities and manufactures within their own dominions, ſo as to diminiſh or render uſeleſs their importations, have endeavoured to entice workmen from other countries, by high ſalaries, privileges, &c. Many perſons pretending to be ſkilled in various great manufactures, imagining that America muſt be in want of them, and that the Congreſs would probably be diſpoſed to imitate the princes above-mentioned, have propoſed to go over, on condition of having their paſſages paid, lands given, ſalaries appointed, excluſive privileges for terms of years, &c. Such perſons, on reading the articles of confederation, will find that the Congreſs have no power committed to them, or money put into their hands, for ſuch purpoſes; and that if any ſuch encouragement is given, it muſt be by the government of ſome ſeparate ſtate. This, however, has rarely been done in America; and when it has been done, it has rarely ſucceeded, ſo as to eſtabliſh a manufacture, which the country was not yet ſo ripe for as to encourage private perſons to ſet it up; labour being generally too dear there, and hands difficult to be kept together, every one deſiring to be a maſter, and the cheapneſs of land inclining many to leave trades for agriculture. Some indeed have met with ſucceſs, and are carried on to advantage; but they are generally ſuch as require only a few hands, or wherein great part of the work is performed by machines. Goods that

are bulky, and of ſo ſmall value as not well to bear the expence of freight, may often be made cheaper in the country than they can be imported; and the manufacture of ſuch goods will be profitable wherever there is a ſufficient demand. The farmers in America produce indeed a good deal of wool and flax; and none is exported, it is all worked up; but it is in the way of domeſtic manufacture for the uſe of the family. The buying up quantities of wool and flax, with the deſign to employ ſpinners, weavers, &c. and form great eſtabliſhments, producing quantities of linen and woollen goods for ſale, has been ſeveral times attempted in different provinces; but thoſe projects have generally failed, goods of equal value being imported cheaper. And when the governments have been ſolicited to ſupport ſuch ſchemes by encouragements, in money, or by impoſing duties on importation of ſuch goods, it has been generally refuſed, on this principle, that if the country is ripe for the manufacture, it may be carried on by private perſons to advantage; and if not, it is a folly to think of forcing nature. Great eſtabliſhments of manufacture, require great numbers of poor to do the work for ſmall wages; thoſe poor are to be found in Europe, but will not be found in America, till the lands are all taken up and cultivated, and the exceſs of people who cannot get land want employment. The manufacture of ſilk, they ſay, is natural in France, as that of cloth in England,

England, becauſe each country produces in plenty the firſt material: but if England will have a manufacture of ſilk as well as that of cloth, and France of cloth as well as that of ſilk, theſe unnatural operations muſt be ſupported by mutual prohibitions, or high duties on the importation of each others goods; by which means the workmen are enabled to tax the home conſumer by greater prices, while the higher wages they receive makes them neither happier nor richer, ſince they only drink more and work leſs. Therefore the governments in America do nothing to encourage ſuch projects. The people, by this means, are not impoſed on, either by the merchant or mechanic; if the merchant demands too much profit on imported ſhoes, they buy of the ſhoemaker; and if he aſks too high a price, they take them of the merchant: thus the two profeſſions are checks on each other. The ſhoemaker, however, has, on the whole, a conſiderable profit upon his labour in America, beyond what he had in Europe, as he can add to his price a ſum nearly equal to all the expences of freight and commiſſion, riſque or inſurance, &c. neceſſarily charged by the merchant. And the caſe is the ſame with the workmen in every other mechanic art. Hence it is, that artiſans generally live better and more eaſily in America than in Europe; and ſuch as are good œconomiſts, make a comfortable proviſion for age, and for their children.

children. Such may, therefore, remove with advantage to America.

In the old long-ſettled countries of Europe, all arts, trades, profeſſions, farms, &c. are ſo full, that it is difficult for a poor man, who has children, to place them where they may gain, or learn to gain, a decent livelihood. The artiſans, who fear creating future rivals in buſineſs, refuſe to take apprentices, but upon conditions of money, maintenance, or the like, which the parents are unable to comply with. Hence the youth are dragged up in ignorance of every gainful art, and obliged to become ſoldiers or ſervants, or thieves, for a ſubſiſtence. In America, the rapid increaſe of inhabitants takes away that fear of rivalſhip, and artiſans willingly receive apprentices from the hope of profit by their labour, during the remainder of the time ſtipulated, after they ſhall be inſtructed. Hence it is eaſy for poor families to get their children inſtructed; for the artiſans are ſo deſirous of apprentices, that many of them will even give money to the parents, to have boys from ten to fifteen years of age bound apprentices to them, till the age of twenty-one; and many poor parents have, by that means, on their arrival in the country, raiſed money enough to buy land ſufficient to eſtabliſh themſelves, and to ſubſiſt the reſt of their family by agriculture. Theſe contracts for apprentices are made before a magiſtrate, who regulates the agreement according to reaſon and juſtice; and having

ing in view the formation of a future uſeful citizen, obliges the maſter to engage by a written indenture, not only that, during the time of ſervice ſtipulated, the apprentice ſhall be duly provided with meat, drink, apparel, waſhing, and lodging, and at its expiration with a compleat new ſuit of clothes, but alſo that he ſhall be taught to read, write, and caſt accompts; and that he ſhall be well inſtructed in the art or profeſſion of his maſter, or ſome other, by which he may afterwards gain a livelihood, and be able in his turn to raiſe a family. A copy of this indenture is given to the apprentice or his friends, and the magiſtrate keeps a record of it, to which recourſe may be had, in caſe of failure by the maſter in any point of performance. This deſire among the maſters to have more hands employed in working for them, induces them to pay the paſſages of young perſons, of both ſexes, who on their arrival agree to ſerve them one, two, three, or four years; thoſe who have already learned a trade, agreeing for a ſhorter term, in proportion to their ſkill, and the conſequent immediate value of their ſervice; and thoſe who have none, agreeing for a longer term, in conſideration of being taught an art their poverty would not permit them to acquire in their own country.

The almoſt general mediocrity of fortune that prevails in America, obliging its people to follow ſome buſineſs for ſubſiſtence, thoſe vices that ariſe uſually from idleneſs, are in a great

great meaſure prevented. Induſtry and conſtant employment are great preſervatives of the morals and virtue of a nation. Hence bad examples to youth are more rare in America, which muſt be a comfortable conſideration to parents. To this may be truly added, that ſerious religion, under its various denominations, is not only tolerated, but reſpected and practiſed. Atheiſm is unknown there; infidelity rare and ſecret; ſo that perſons may live to a great age in that country without having their piety ſhocked by meeting with either an atheiſt or an infidel. And the Divine Being ſeems to have manifeſted his approbation of the mutual forbearance and kindneſs with which the different ſects treat each other, by the remarkable proſperity with which he has been pleaſed to favour the whole country.

REMARKS

CONCERNING THE

SAVAGES OF NORTH-AMERICA.

SAVAGES we call them, becauſe their manners differ from ours, which we think the perfection of civility; they think the ſame of theirs.

Perhaps if we could examine the manners of different nations with impartiality, we ſhould find no people ſo rude as to be without any rules of politeneſs; nor any ſo polite as not to have ſome remains of rudeneſs.

The Indian men, when young, are hunters and warriors; when old, counſellors; for all their government is by the counſel or advice of the ſages; there is no force, there are no priſons, no officers to compel obedience, or inflict puniſhment. Hence they generally ſtudy oratory; the beſt ſpeaker having the moſt influence. The Indian women till the ground, dreſs the food, nurſe and bring up the children, and preſerve and hand down to poſterity the memory of public tranſactions. Theſe employments of men and women are accounted natural and honourable. Having few artificial wants, they have abundance of leiſure for improvement by converſation. Our laborious manner of

of life compared with theirs, they eſteem ſlaviſh and baſe; and the learning on which we value ourſelves, they regard as frivolous and uſeleſs. An inſtance of this occurred at the treaty of Lancaſter in Pennſilvania, anno 1744, between the government of Virginia and the Six Nations. After the principal buſineſs was ſettled, the commiſſioners from Virginia acquainted the Indians by a ſpeech, that there was at Williamſburg a college with a fund, for educating Indian youth; and that if the chiefs of the Six Nations would ſend down half a dozen of their ſons to that college, the government would take care that they ſhould be well provided for, and inſtructed in all the learning of the white people. It is one of the Indian rules of politeneſs not to anſwer a public propoſition the ſame day that it is made; they think it would be treating it as a light matter; and that they ſhew it reſpect by taking time to conſider it, as of a matter important. They therefore deferred their anſwer till the day following; when their ſpeaker began, by expreſſing their deep ſenſe of the kindneſs of the Virginia government, in making them that offer; "for "we know," ſays he, "that you highly "eſteem the kind of learning taught in thoſe "colleges, and that the maintenance of our "young men, while with you, would be very "expenſive to you. We are convinced, there-"fore, that you mean to do us good by your "propoſal, and we thank you heartily. But

"you

" you who are wiſe muſt know, that different
" nations have different conceptions of things;
" and you will therefore not take it amiſs, if
" our ideas of this kind of education happen
" not to be the ſame with yours. We have
" had ſome experience of it: ſeveral of our
" young people were formerly brought up at
" the colleges of the northern provinces;
" they were inſtructed in all your ſciences;
" but when they came back to us, they were
" bad runners; ignorant of every means of
" living in the woods; unable to bear either
" cold or hunger; knew neither how to build
" a cabin, take a deer, or kill an enemy; ſpoke
" our language imperfectly; were therefore
" neither fit for hunters, warriors, or counſel-
" lors; they were totally good for nothing.
" We are however not the leſs obliged by
" your kind offer, though we decline accept-
" ing it: and to ſhow our grateful ſenſe of it,
" if the gentlemen of Virginia will ſend us a
" dozen of their ſons, we will take great care
" of their education, inſtruct them in all we
" know, and make *men* of them."

Having frequent occaſions to hold public councils, they have acquired great order and decency in conducting them. The old men ſit in the foremoſt ranks, the warriors in the next, and the women and children in the hindmoſt. The buſineſs of the women is to take exact notice of what paſſes, imprint it in their memories, for they have no writing, and communicate

cate it to their children. They are the records of the council, and they preſerve tradition of the ſtipulations in treaties a hundred years back; which, when we compare with our writings, we always find exact. He that would ſpeak, riſes. The reſt obſerve a profound ſilence. When he has finiſhed, and ſits down, they leave him five or ſix minutes to recollect, that if he has omitted any thing he intended to ſay, or has any thing to add, he may riſe again, and deliver it. To interrupt another, even in common converſation, is reckoned highly indecent. How different this is from the conduct of a polite Britiſh Houſe of Commons, where ſcarce a day paſſes without ſome confuſion, that makes the Speaker hoarſe in calling *to order*; and how different from the mode of converſation in many polite companies of Europe, where, if you do not deliver your ſentence with great rapidity, you are cut off in the middle of it by the impatient loquacity of thoſe you converſe with, and never ſuffered to finiſh it!

The politeneſs of theſe ſavages in converſation, is, indeed, carried to exceſs; ſince it does not permit them to contradict or deny the truth of what is aſſerted in their preſence. By this means they indeed avoid diſputes; but then it becomes difficult to know their minds, or what impreſſion you make upon them. The miſſionaries who have attempted to convert them to Chriſtianity, all complain of this as

one

one of the great difficulties of their miſſion. The Indians hear with patience the truths of the goſpel explained to them, and give their uſual tokens of aſſent and approbation: you would think they were convinced. No ſuch matter. It is mere civility.

A Swediſh miniſter having aſſembled the chiefs of the Saſquehanah Indians, made a ſermon to them, acquainting them with the principal hiſtorical facts on which our religion is founded; ſuch as the fall of our firſt parents by eating an apple; the coming of Chriſt to repair the miſchief; his miracles and ſuffering, &c.——When he had finiſhed, an Indian orator ſtood up to thank him. "What "you have told us," ſays he "is all very good. "It is indeed bad to eat apples. It is better to "make them all into cyder. We are much "obliged by your kindneſs in coming ſo far, "to tell us thoſe things which you have heard "from your mothers. In return, I will tell "you ſome of thoſe we have heard from "ours.

"In the beginning, our fathers had only "the fleſh of animals to ſubſiſt on; and if "their hunting was unſucceſsful, they were "ſtarving. Two of our young hunters hav-"ing killed a deer, made a fire in the "woods to broil ſome parts of it. When "they were about to ſatisfy their hunger, they "beheld a beautiful young woman deſcend "from the clouds, and ſeat herſelf on that hill

" which you ſee yonder among the Blue Moun-
" tains. They ſaid to each other, it is a ſpirit
" that perhaps has ſmelt our broiling veniſon,
" and wiſhes to eat of it: let us offer ſome to
" to her. They preſented her with the tongue:
" ſhe was pleaſed with the taſte of it, and ſaid,
" Your kindneſs ſhall be rewarded. Come to
" this place after thirteen moons, and you ſhall
" find ſomething that will be of great benefit
" in nouriſhing you and your children to the
" lateſt generations. They did ſo, and to their
" ſurpriſe, found plants they had never ſeen
" before; but which, from that ancient time,
" have been conſtantly cultivated among us,
" to our great advantage. Where her right hand
" had touched the ground, they found maize;
" where her left hand had touched it, they
" found kidney-beans; and where her back-
" ſide had ſat on it, they found tobacco." The good miſſionary, diſguſted with this idle tale, ſaid, " What I delivered to you were ſacred
" truths; but what you tell me is mere fable,
" fiction, and falſehood." The Indian, offended, replied, " My brother, it ſeems your friends
" have not done you juſtice in your education;
" they have not well inſtructed you in the rules
" of common civility. You ſaw that we, who
" underſtand and practiſe thoſe rules, believed
" all your ſtories, why do you refuſe to believe
" ours?"

When any of them come into our towns, our people are apt to crowd round them, gaze

upon them, and incommode them where they deſire to be private; this they eſteem great rudeneſs, and the effect of the want of inſtruction in the rules of civility and good manners. "We have," ſay they, "as much curioſity as you, and when you come into our towns, we wiſh for opportunities of looking at you; but for this purpoſe we hide ourſelves behind buſhes where you are to paſs, and never intrude ourſelves into your company."

Their manner of entering one anothers villages has likewiſe its rules. It is reckoned uncivil in travelling ſtrangers to enter a village abrubtly, without giving notice of their approach. Therefore, as ſoon as they arrive within hearing, they ſtop and hollow, remaining there till invited to enter. Two old men uſually come out to them, and lead them in. There is in every village a vacant dwelling, called the ſtrangers' houſe. Here they are placed, while the old men go round from hut to hut, acquainting the inhabitants that ſtrangers are arrived, who are probably hungry and weary; and every one ſends them what he can ſpare of victuals, and ſkins to repoſe on. When the ſtrangers are refreſhed, pipes and tobacco are brought; and then, but not before, converſation begins, with enquiries who they are, whither bound, what news, &c. and it uſually ends with offers of ſervice; if the ſtrangers have occaſion of guides, or any neceſſaries for continuing their

journey; and nothing is exacted for the entertainment.

The ſame hoſpitality, eſteemed among them as a principal virtue, is practiſed by private perſons; of which *Conrad Weiſer*, our interpreter, gave me the following inſtance. He had been naturalized among the Six Nations, and ſpoke well the Mohock language. In going through the Indian country, to carry a meſſage from our governor to the council at *Onondaga*, he called at the habitation of *Canaſſetego*, an old acquaintance, who embraced him, ſpread furs for him to ſit on, placed before him ſome boiled beans and veniſon, and mixed ſome rum and water for his drink. When he was well refreſhed, and had lit his pipe, Canaſſetego began to converſe with him: aſked how he had fared the many years ſince they had ſeen each other, whence he then came, what occaſioned the journey, &c. Conrad anſwered all his queſtions; and when the diſcourſe began to flag, the Indian, to continue it, ſaid, "Conrad, you have lived long among the white people, and know ſomething of their cuſtoms; I have been ſometimes at Albany, and have obſerved, that once in ſeven days they ſhut up their ſhops, and aſſemble all in the great houſe; tell me, what it is for? What do they do there?" "They meet there," ſays Conrad, "to hear and learn *good things*." "I do not doubt," ſays the Indian, "that they tell you ſo; they have told

" told me the ſame: but I doubt the truth
" of what they ſay, and I will tell you my
" reaſons. I went lately to Albany to ſell my
" ſkins, and buy blankets, knives, powder,
" rum, &c. You know I uſed generally to
" deal with Hans Hanſon; but I was a little
" inclined this time to try ſome other mer-
" chants. However, I called firſt upon Hans,
" and aſked him what he would give for bea-
" ver. He ſaid he could not give more than
" four ſhillings a pound: but, ſays he, I can-
" not talk on buſineſs now; this is the day
" when we meet together to learn *good things*,
" and I am going to the meeting. So I thought
" to myſelf, ſince I cannot do any buſineſs to-
" day, I may as well go to the meeting too,
" and I went with him. There ſtood up a man
" in black, and began to talk to the people
" very angrily. I did not underſtand what he
" ſaid; but perceiving that he looked much
" at me, and at Hanſon, I imagined he was
" angry at ſeeing me there; ſo I went out,
" ſat down near the houſe, ſtruck fire, and lit
" my pipe, waiting till the meeting ſhould
" break up. I thought too, that the man had
" mentioned ſomething of beaver, and I ſuſ-
" pected it might be the ſubject of their meet-
" ing. So when they came out, I accoſted my
" merchant. " Well, Hans," ſays I, " I hope
" you have agreed to give more than four
" ſhillings a pound." "No," ſays he, " I can-
" not give ſo much. I cannot give more than

" three ſhillings and ſixpence." I then ſpoke " to ſeveral other dealers, but they all ſung " the ſame ſong, three and ſixpence, three and " ſixpence. This made it clear to me that my " ſuſpicion was right; and that whatever they " pretended of meeting to learn *good things*, " the real purpoſe was to conſult how to cheat " Indians in the price of beaver. Conſider but " a little, Conran, and you muſt be of my opi- " nion. If they met ſo often to learn *good* " *things*, they would certainly have learned " ſome before this time. But they are ſtill " ignorant. You know our practice. If a " white man in travelling through our coun- " try, enters one of our cabins, we all treat " him as I treat you; we dry him if he is wet, " we warm him if he is cold, and give him " meat and drink, that he may allay his thirſt " and hunger; and we ſpread ſoft furs for him " to reſt and ſleep on: we demand nothing in " return *. But if I go into a white man's " houſe at Albany, and aſk for victuals and " drink, they ſay, Where is your money; and " if I have none, they ſay, Get out, you Indian " dog. You ſee they have not yet learned thoſe

* It is remarkable, that in all ages and countries, hoſpitality has been allowed as the virtue of thoſe, whom the civilized were pleaſed to call Barbarians; the Greeks celebrated the Scythians for it. The Saracens poſſeſſed it eminently; and it is to this day the reigning virtue of the wild Arabs. St. Paul too, in the relation of his voyage and ſhipwreck, on the iſland of Melita, ſays, " The barbarous people ſhewed us no little kindneſs; for " they kindled a fire, and received us every one, becauſe of the " preſent rain, and becauſe of the cold."

" little

" little *good things*, that we need no meetings
" to be inſtructed in, becauſe our mothers
" taught them to us when we were children;
" and therefore it is impoſſible their meet-
" ings ſhould be, as they ſay, for any ſuch
" purpoſe, or have any ſuch effect; they
" are only to contrive *the cheating of Indians*
" *in the price of beaver.*"

THE

INTERNAL STATE OF AMERICA,

Being a true Deſcription of the Intereſt and Policy of that vaſt Continent.

THERE is a tradition, that in the planting of New-England, the firſt ſettlers met with many difficulties and hardſhips, as is generally the caſe when a civilized people attempt eſtabliſhing themſelves in a wilderneſs country. Being piouſly diſpoſed, they ſought relief from Heaven, by laying their wants and diſtreſſes before the Lord in frequent ſet days of faſting and prayer. Conſtant meditation and diſcourſe on theſe ſubjects kept their minds gloomy and diſcontented; and, like the children of Iſrael, there were many diſpoſed to return to that Egypt which perſecution had induced them to abandon. At length, when it was propoſed in the aſſembly to proclaim another faſt, a farmer of plain ſenſe roſe, and remarked, that the inconveniences they ſuffered, and concerning which they had ſo often wearied Heaven with their complaints, were not ſo great as they might have expected, and were diminiſhing every day as the colony ſtrengthened; that the earth began to reward their labour, and

to

to furniſh liberally for their ſubſiſtence; that the ſeas and rivers were found full of fiſh, the air ſweet, the climate healthy; and, above all, that they were there in the full enjoyment of liberty, civil and religious: he therefore thought, that reflecting and converſing on theſe ſubjects would be more comfortable, as tending more to make them contented with their ſituation; and that it would be more becoming the gratitude they owed to the Divine Being, if, inſtead of a faſt, they ſhould proclaim a thankſgiving. His advice was taken; and from that day to this they have, in every year, obſerved circumſtances of public felicity ſufficient to furniſh employment for a thankſgiving-day, which is therefore conſtantly ordered and religiouſly obſerved.

I ſee in the public news-papers of different ſtates frequent complaints of *hard times, deadneſs of trade, ſcarcity of money*, &c. &c. It is not my intention to aſſert or maintain that theſe complaints are entirely without foundation. There can be no country or nation exiſting, in which there will not be ſome people ſo circumſtanced as to find it hard to gain a livelihood; people who are not in the way of any profitable trade, and with whom money is ſcarce, becauſe they have nothing to give in exchange for it; and it is always in the power of a ſmall number to make a great clamour. But let us take a cool view of the general ſtate of our affairs, and perhaps

haps the proſpect will appear leſs gloomy than has been imagined.

The great buſineſs of the Continent is agriculture. For one artiſan, or merchant, I ſuppoſe we have at leaſt 100 farmers, by far the greateſt part cultivators of their own fertile lands, from whence many of them draw not only food neceſſary for their ſubſiſtence, but the materials of their cloathing, ſo as to need very few foreign ſupplies; while they have a ſurplus of productions to diſpoſe of, whereby wealth is gradually accumulated. Such has been the goodneſs of Divine Providence to theſe regions, and ſo favourable the climate, that ſince the three or four years of hardſhip in the firſt ſettlement of our fathers here, a famine or ſcarcity has never been heard of amongſt us; on the contrary, though ſome years may have been more, and others leſs plentiful, there has always been proviſion enough for ourſelves, and a quantity to ſpare for exportation. And although the crops of laſt year were generally good, never was the farmer better paid for the part he can ſpare commerce, as the publiſhed price currents abundantly teſtify. The lands he poſſeſſes are alſo continually riſing in value with the increaſe of population; and, on the whole, he is enabled to give ſuch good wages to thoſe who work for him, that all who are acquainted with the old world muſt agree, that in no part of it are the labouring poor ſo gene-

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rally well fed, well cloathed, well lodged, and well paid, as in the United States of America.

If we enter the cities, we find that, ſince the revolution, the owners of houſes and lots of ground have had their intereſt vaſtly augmented in value; rents have riſen to an aſtoniſhing height, and thence encouragement to increaſe building, which gives employment to an abundance of workmen, as does alſo the increaſed luxury and ſplendour of living of the inhabitants thus made richer. Theſe workmen all demand and obtain much higher wages than any other part of the world would afford them, and are paid in ready money. This rank of people therefore do not, or ought not, to complain of hard times; and they make a very conſiderable part of the city inhabitants.

At the diſtance I live from our American fiſheries, I cannot ſpeak of them with any degree of certainty; but I have not heard that the labour of the valuable race of men employed in them is worſe paid, or that they meet with leſs ſucceſs, than before the revolution. The whalemen indeed have been deprived of one market for their oil; but another, I hear, is opening for them, which it is hoped may be equally advantageous; and the demand is conſtantly increaſing for their ſpermaceti candles, which therefore bear a much higher price than formerly.

There remain the merchants and ſhopkeepers. Of theſe, though they make but a ſmall part of the

the whole nation, the number is conſiderable, too great indeed for the buſineſs they are employed in; for the conſumption of goods in every country has its limits; the faculties of the people, that is, their ability to buy and pay, is equal only to a certain quantity of merchandize. If merchants calculate amiſs on this proportion, and import too much, they will of courſe find the ſale dull for the overplus, and ſome of them will ſay that trade languiſhes. They ſhould, and doubtleſs will, grow wiſer by experience, aud import leſs. If too many artificers in town, and farmers from the country, flattering themſelves with the idea of leading eaſier lives, turn ſhopkeepers, the whole natural quantity of that buſineſs divided among them all may afford too ſmall a ſhare for each, and occaſion complaints that trading is dead; theſe may alſo ſuppoſe that it is owing to ſcarcity of money, while, in fact, it is not ſo much from the fewneſs of buyers, as from the exceſſive number of ſellers, that the miſchief ariſes; and, if every ſhopkeeping farmer and mechanic would return to the uſe of his plough and working tools, there would remain of widows, and other women, ſhopkeepers ſufficient for the buſineſs, which might then afford them a comfortable maintenance.

Whoever has travelled through the various parts of Europe, and obſerved how ſmall is the proportion of people in affluence or eaſy circumſtances there, compared with thoſe in po-

verty and miſery; the few rich and haughty landlords, the multitude of poor, abject, rack-rented, tythe-paying tenants, and half-paid and half-ſtarved ragged labourers; and views here the happy mediocrity that ſo generally prevails throughout theſe ſtates, where the cultivator works for himſelf, and ſupports his family in decent plenty; will, methinks, ſee abundant reaſon to bleſs Divine Providence for the evident and great difference in our favour, and be convinced that no nation known to us enjoys a greater ſhare of human felicity.

It is true, that in ſome of the ſtates there are parties and diſcords; but let us look back, and aſk if we were ever without them? Such will exiſt wherever there is liberty; and perhaps they help to preſerve it. By the colliſion of different ſentiments, ſparks of truth are ſtruck out, and political light is obtained. The different factions, which at preſent divide us, aim all at the public good; the differences are only about the various modes of promoting it. Things, actions, meaſures, and objects of all kinds, preſent themſelves to the minds of men in ſuch a variety of lights, that it is not poſſible we ſhould all think alike at the ſame time on every ſubject, when hardly the ſame man retains at all times the ſame ideas of it. Parties are therefore the common lot of humanity; and ours are by no means more miſchievous or leſs beneficial than thoſe of other countries, nations, and ages, enjoying in the

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ſame degree the great bleſſing of political liberty.

Some indeed among us are not ſo much grieved for the preſent ſtate of our affairs, as apprehenſive for the future. The growth of luxury alarms them, and they think we are from that alone in the high road to ruin. They obſerve, that no revenue is ſufficient without œconomy, and that the moſt plentiful income of a whole people from the natural productions of their country may be diſſipated in vain and needleſs expences, and poverty be introduced in the place of affluence.—This may be poſſible. It however rarely happens: for there ſeems to be in every nation a greater proportion of induſtry and frugality, which tend to enrich, than of idleneſs and prodigality, which occaſion poverty, ſo that upon the whole there is a continual accumulation. Reflect what Spain, Gaul, Germany, and Britain were in the time of the Romans, inhabited by people little richer than our ſavages, and conſider the wealth they at preſent poſſeſs, in numerous well-built cities, improved farms, rich moveables, magazines ſtocked with valuable manufactures, to ſay nothing of plate, jewels, and coined money; and all this, notwithſtanding their bad, waſteful, plundering governments, and their mad deſtructive wars; and yet luxury and extravagant living has never ſuffered much reſtraint in thoſe countries. Then conſider the great proportion

portion of induſtrious frugal farmers inhabiting the interior parts of theſe American ſtates, and of whom the body of our nation conſiſts, and judge whether it is poſſible that the luxury of our ſea-ports can be ſufficient to ruin ſuch a country.—If the importation of foreign luxuries could ruin a people, we ſhould probably have been ruined long ago: for the Britiſh nation claimed a right, and practiſed it, of importing among us not only the ſuperfluities of their own production, but thoſe of every nation under heaven; we bought and conſumed them, and yet we flouriſhed and grew rich. At preſent our independent governments may do what we could not then do, diſcourage by heavy duties, or prevent by heavy prohibitions, ſuch importations, and thereby grow richer;—if, indeed, which may admit of diſpute, the deſire of adorning ourſelves with fine clothes, poſſeſſing fine furniture, with elegant houſes, &c. is not, by ſtrongly inciting to labour and induſtry, the occaſion of producing a greater value than is conſumed in the gratification of that deſire.

The agriculture and fiſheries of the United States are the great ſources of our increaſing wealth. He that puts a ſeed into the earth is recompenſed, perhaps, by receiving forty out of it; and he who draws a fiſh out of our water, draws up a piece of ſilver.

Let us (and there is no doubt but we ſhall) be attentive to theſe, and than the power of rivals,

rivals, with all their reſtraining and prohibiting acts, cannot much hurt us. We are ſons of the earth and ſeas, and, like Antæus in the fable, if in wreſtling with a Hercules we now and then receive a fall, the touch of our parents will communicate to us freſh ſtrength and vigour to renew the conteſt,

Letter from Dr. B. FRANKLIN *to* B——V———, *Eſq; on the Criminal Laws, and the Practice of Privateering.*

My dear Friend, March 14th, 1785.

AMONG the pamphlets you lately ſent me, was one, intitled, *Thoughts on Executive Juſtice:* In return for that, I ſend you a French one on the ſame ſubject, *Obſervations concernant l'Exécution de l'Article II. de la Déclaration ſur le Vol.* They are both addreſſed to the judges, but written, as you will ſee, in a very different ſpirit. The Engliſh author is for hanging *all* thieves. The Frenchman is for proportioning puniſhments to offences.

If we really believe, as we profeſs to believe, that the law of Moſes was the law of God, the dictate of divine wiſdom, infinitely ſuperior to human; on what principles do we ordain death as the puniſhment of an offence, which, according to that law, was only to be puniſhed by a reſtitution of fourfold? To put a man to death for an offence which does not deſerve death, is it not a murder? And, as the French writer ſays, *Doit-on punir un délit contre la ſociété par un crime contre la nature?*

Superfluous property is the creature of ſociety. Simple and mild laws were ſufficient to guard the property that was merely neceſſary. The ſavage's bow, his hatchet, and his coat of ſkins, were ſufficiently ſecured, without law,

by the fear of perſonal reſentment and retaliation. When, by virtue of the firſt laws, part of the ſociety accumulated wealth and grew powerful, they enacted others more ſevere, and would protect their property, at the expence of humanity. This was abuſing their power, and commencing a tyranny. If a ſavage, before he entered into ſociety, had been told — "Your "neighbour, by this means, may become "owner of an hundred deer; but if your bro-"ther, or your ſon, or yourſelf, having no "deer of your own, and being hungry, ſhould "kill one, an infamous death muſt be the "conſequence," he would probably have preferred his liberty, and his common right of killing any deer, to all the advantages of ſociety that might be propoſed to him.

That it is better a hundred guilty perſons ſhould eſcape, than that one innocent perſon ſhould ſuffer, is a maxim that has been long and generally approved; never, that I know of, controverted. Even the ſanguinary author of the *Thoughts* agrees to it, adding well, "that the very thought of *injured* innocence, "and much more that of *ſuffering* innocence, "muſt awaken all our tendereſt and moſt "compaſſionate feelings, and at the ſame time "raiſe our higheſt indignation againſt the in-"ſtruments of it. But," he adds, "there is no "danger of *either*, from a ſtrict adherence to "the laws." — Really! — Is it then impoſſible to make an unjuſt law? and if the law itſelf

be unjuſt, may it not be the very "inſtrument" which ought "to raiſe the author's and every "body's higheſt indignation?" I ſee, in the laſt news-papers from London, that a woman is capitally convicted at the Old Bailey, for privately ſtealing out of a ſhop ſome gauze, value fourteen ſhillings and three pence: Is there any proportion between the injury done by a theft, value fourteen ſhillings and three pence, and the puniſhment of a human creature, by death, on a gibbet? Might not that woman, by her labour, have made the reparation ordained by God, in paying fourfold? Is not all puniſhment inflicted beyond the merit of the offence, ſo much puniſhment of innocence? In this light, how vaſt is the annual quantity, of not only *injured* but *ſuffering* innocence, in almoſt all the civilized ſtates of Europe!

But it ſeems to have been thought, that this kind of innocence may be puniſhed by way of *preventing* crimes. I have read, indeed, of a cruel Turk, in Barbary, who, whenever he bought a new Chriſtian ſlave, ordered him immediately to be hung up by the legs, and to receive a hundred blows of a cudgel, on the ſoles of his feet, that the ſevere ſenſe of the puniſhment, and fear of incurring it thereafter, might prevent the faults that ſhould merit it. Our author himſelf would hardly approve entirely of this Turk's conduct in the government of ſlaves, and yet he appears to re-

commend ſomething like it for the government of Engliſh ſubjects, when he applauds the reply of Judge Burnet to the convict horſe-ſtealer, who being aſked what he had to ſay why judgment of death ſhould not paſs againſt him, and anſwering, that it was hard to hang a man for *only* ſtealing a horſe, was told by the judge, "Man, thou art not to be hanged *only* for ſteal-"a horſe, but that horſes may not be ſtolen." The man's anſwer, if candidly examined, will, I imagine, appear reaſonable, as being founded on the eternal principle of juſtice and equity, that puniſhments ſhould be proportioned to offences; and the judge's reply brutal and unreaſonable, though the writer "wiſhes all "judges to carry it with them whenever they "go the circuit, and to bear it in their minds, "as containing a wiſe reaſon for all the penal "ſtatutes which they are called upon to put "in execution. It at once illuſtrates," ſays he, "the true grounds and reaſons of all capital "puniſhments whatſoever, namely, that every "man's property, as well as his life, may be "held ſacred and inviolate." Is there then no difference in value between property and life? If I think it right that the crime of murder ſhould be puniſhed with death, not only as an equal puniſhment of the crime, but to prevent other murders, does it follow that I muſt approve of inflicting the ſame puniſhment for a little invaſion on my property by theft? If I am not myſelf ſo barbarous, ſo bloody-minded,

and

and revengeful, as to kill a fellow-creature for ſtealing from me fourteen ſhillings and three pence, how can I approve of a law that does it? Monteſquieu, who was himſelf a judge, endeavours to impreſs other maxims. He muſt have known what humane judges feel on ſuch occaſions, and what the effects of thoſe feelings; and, ſo far from thinking that ſevere and exceſſive puniſhments prevent crimes, he aſſerts, as quoted by our French writer, that

" *L'atrocité des loix en empêche l'exécution.*

" *Lorſque la peine eſt ſans meſure on eſt ſouvent obligé de lui préférer l'impunité.*

" *La cauſe de tous les relâchemens vient de l'impunité des crimes et non de la modération des peines.*"

It is ſaid by thoſe who know Europe generally, that there are more thefts committed and puniſhed annually in England, than in all the other nations put together. If this be ſo, there muſt be a cauſe or cauſes for ſuch depravity in our common people. May not one be the deficiency of juſtice and morality in our national government, manifeſted in our oppreſſive conduct to ſubjects, and unjuſt wars on our neighbours? View the long-perſiſted-in, unjuſt, monopolizing treatment of Ireland, at length acknowledged! View the plundering government exerciſed by our merchants in the Indies; the confiſcating war made upon the American colonies; and, to ſay nothing of thoſe upon France and Spain, view the late

war upon Holland, which was ſeen by impartial Europe in no other light than that of a war of rapine and pillage, the hopes of an immenſe and eaſy prey being its only apparent, and probably its true and real motive and encouragement. Juſtice is as ſtrictly due between neighbour nations as between neighbour citizens. A highwayman is as much a robber when he plunders in a gang as when ſingle; and a nation that makes an unjuſt war is only a great gang. After employing your people in robbing the Dutch, is it ſtrange that, being put out of that employ by peace, they ſtill continue robbing, and rob one another? *Piraterie*, as the French call it, or privateering, is the univerſal bent of the Engliſh nation, at home and abroad, wherever ſettled. No leſs than ſeven hundred privateers were, it is ſaid, commiſſioned in the laſt war! Theſe were fitted out by merchants, to prey upon other merchants, who had never done them any injury. Is there probably any one of thoſe privateering merchants of London, who were ſo ready to rob the merchants of Amſterdam, that would not as readily plunder another London merchant of the next ſtreet, if he could do it with the ſame impunity! The avidity, the *alieni appetens* is the ſame; it is the fear alone of the gallows that makes the difference. How then can a nation, which, among the honeſteſt of its people, has ſo many thieves by inclination, and whoſe government encouraged and commiſſioned

miſſioned no leſs than ſeven hundred gangs of robbers; how can ſuch a nation have the face to condemn the crime in individuals, and hang up twenty of them in a morning! It naturally puts one in mind of a Newgate anecdote. One of the priſoners complained, that in the night ſomebody had taken his buckles out of his ſhoes. "What the devil!" ſays another, "have we then *thieves* amongſt us? It muſt "not be ſuffered. Let us ſearch out the rogue, "and pump him to death."

There is, however, one late inſtance of an Engliſh merchant who will not profit by ſuch ill-gotten gain. He was, it ſeems, part-owner of a ſhip, which the other owners thought fit to employ as a letter of marque, and which took a number of French prizes. The booty being ſhared, he has now an agent here enquiring, by an advertiſement in the Gazette, for thoſe who ſuffered the loſs, in order to make them, as far as in him lies, reſtitution. This conſcientious man is a Quaker. The Scotch preſbyterians were formerly as tender; for there is ſtill extant an ordinance of the town-council of Edinburgh, made ſoon after the Reformation, forbidding "the purchaſe of prize goods, "under pain of loſing the freedom of the "burgh for ever, with other puniſhment at "the will of the magiſtrate; the practice of "making prizes being contrary to good con-"ſcience, and the rule of treating Chriſ-"tian brethren as we would wiſh to be "treated;

" treated; and ſuch goods *are not to be ſold by* " *any godly men within this burgh.*" The race of theſe godly men in Scotland is probably extinct, or their principles abandoned, ſince, as far as that nation had a hand in promoting the war againſt the Colonies, prizes and confiſcations are believed to have been a conſiderable motive.

It has been for ſome time a generally-received opinion, that a military man is not to enquire whether a war be juſt or unjuſt; he is to execute his orders. All princes, who are diſpoſed to become tyrants, muſt probably approve of this opinion, and be willing to eſtabliſh it; but is it not a dangerous one? Since, on that principle, if the tyrant commands his army to attack and deſtroy, not only an unoffending neighbour nation, but even his own ſubjects, the army is bound to obey. A negro ſlave in our Colonies, being commanded by his maſter to rob or murder a neighbour, or do any other immoral act, may refuſe, and the magiſtrate will protect him in his refuſal. The ſlavery then of a ſoldier is worſe than that of a negro! A conſcientious officer, if not reſtrained by the apprehenſion of its being imputed to another cauſe, may indeed reſign, rather than be employed in an unjuſt war; but the private men are ſlaves for life; and they are perhaps incapable of judging for themſelves. We can only lament their fate, and ſtill more

that of a ſailor, who is often dragged by force from his honeſt occupation, and compelled to imbrue his hands in perhaps innnocent blood. But methinks it well behoves merchants (men more enlightened by their education, and perfectly free from any ſuch force or obligation) to conſider well of the juſtice of a war, before they voluntarily engage a gang of ruffians to attack their fellow merchants of a neighbouring nation, to plunder them of their property, and perhaps ruin them and their familes, if they yield it, or to wound, maim, and murder them, if they endeavour to defend it. Yet theſe things are done by Chriſtian merchants, whether a war be juſt or unjuſt, and it can hardly be juſt on both ſides. They are done by Engliſh and American merchants, who, nevertheleſs, complain of private theft, and hang by dozens the thieves they have taught by their own example.

It is high time, for the ſake of humanity, that a ſtop were put to this enormity. The United States of America, though better ſituated than any European nation, to make profit by privateering (moſt of the trade of Europe, with the Weſt Indies, paſſing before their doors) are, as far as in them lies, endeavouring to aboliſh the practice, by offering, in all their treaties with other powers, an article, engaging ſolemnly, that in caſe of future war, no privateer ſhall be commiſſioned on either ſide; and that unarmed merchant-ſhips, on both ſides,

ſides, ſhall purſue their voyages unmoleſted *. This will be a happy improvement of the law of nations. The humane and the juſt cannot but wiſh general ſucceſs to the propoſition.

With unchangeable eſteem and affection,

I am, my dear friend,

Ever yours.

* This offer having been accepted by the late king of Pruſſia, a treaty of amity and commerce was concluded between that monarch and the United States, containing the following humane philanthropic article, in the formation of which Dr. Franklin, as one of the American Plenipotentiaries, was principally concerned; viz.

ART. XXIII.

If war ſhould ariſe between the two contracting parties, the merchants of either country, then reſiding in the other, ſhall be allowed to remain nine months to collect their debts and ſettle their affairs, and may depart freely, carrying off all their effects without moleſtation or hindrance: and all women and children, ſcholars of every faculty, cultivators of the earth, artizans, manufacturers, and fiſhermen, unarmed and inhabiting unfortified towns, villages, or places, and in general all others whoſe occupations are for the common ſubſiſtence and benefit of mankind, ſhall be allowed to continue their reſpective employments, and ſhall not be moleſted in their perſons, nor ſhall their houſes or goods be burnt, or otherwiſe deſtroyed, nor their fields waſted, by the armed force of the enemy into whoſe power, by the events of war, they may happen to fall; but if any thing is neceſſary to be taken from them for the uſe of ſuch armed force, the ſame ſhall be paid for at a reaſonable price. And all merchant and trading veſſels employed in exchanging the products of different places, and thereby rendering the neceſſaries, conveniences, and comforts of human life more eaſy to be obtained, and more general, ſhall be allowed to paſs free and unmoleſted; and neither of the contracting powers ſhall grant or iſſue any commiſſion to any private armed veſſels, empowering them to take or deſtroy ſuch trading veſſels, or interrupt ſuch commerce.